UNIVERSITY OF CALIFORNIA SAN DIEGO

Sculpting Sonic Spaces and Examining the Micro: An Exploration of Creativity and Compositional Practice

A dissertation submitted in partial satisfaction of the requirements for the degree
Doctor of Philosophy

in

Music

by

Theocharis Papatrechas

Committee in charge:

Professor Rand Steiger, Chair
Professor Georgios Anagnostopoulos
Professor Erik Carlson
Professor Lei Liang
Professor Miller Puckette
Professor Steven Schick

2021

The dissertation of Theocharis Papatrechas is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

_____

_____

_____

_____

_____

_____
Chair

University of California San Diego

2021

DEDICATION

To Dimitra and Panayiotis, for encouraging me to dream.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to Professor Rand Steiger for his essential guidance and immense support in all levels of my life the past seven years – one could not ask for a better mentor. Thank you for showing such belief in me and supporting my work generously and unselfishly.

To Professor Lei Liang, for your never-ending support, mentorship, and guidance. Our collaboration over the last three years at Calit2 has been constantly inspirational. Thank you for putting your trust in my work.

I would also like to thank each of the members of my dissertation committee, firstly Professors Miller Puckette, Steven Schick, and Erik Carlson, for their support, encouragements, and patience. My grateful thanks are also extended to Professor Georgios Anagnostopoulos for his generous support, encouragements, and availability.

To my dear friends and colleagues, Rebecca, Dimitris, and Michele for their friendship, energy, ethos, and enormous performative capabilities, and for creating some great art together.

Lastly, to the members of my family, Panayiotis, Dimitra, Stathis, and Evie. Thank you for your continual love and support at every instance of my life, especially when we have been two continents apart for almost a decade.

VITA

2010-2011	Certificate, Sibelius Academy
2012	Bachelor of Arts, Ionian University
2012-2013	Teaching Assistant, Eastman School of Music, University of Rochester
2013-2014	Associate Instructor, Eastman School of Music, University of Rochester
2014	Master of Arts, Eastman School of Music, University of Rochester
2014-2018	Teaching Assistant, University of California San Diego
2018-2020	Research Assistant, University of California San Diego
2020	Associate Instructor, University of California San Diego
2021	Doctor of Philosophy, University of California San Diego

FIELDS OF STUDY

Major Field: Music

Studies in Music Composition
Professors Rand Steiger, Allan Schindler, Ricardo Zohn-Muldoon, Carlos Sanchez-Gutierrez, Lauri Kilpio, Joseph Papadatos, Dimitra Trypani

ABSTRACT OF THE DISSERTATION

Sculpting Sonic Spaces and Examining the Micro: An Exploration of Creativity and Compositional Practice

by

Theocharis Papatrechas

Doctor of Philosophy in Music

University of California San Diego, 2021

Professor Rand Steiger, Chair

This dissertation offers an analytical and ontological insight into my compositional method and creative process. Focusing on three compositional projects produced at UCSD between 2018 and 2020, this dissertation details the synthesis of acoustic and electronics components utilized in my work. Giving special emphasis on the exploration of the facilitation of technology, and annotating the creative journey embarked upon through collaboration, this dissertation outlines the stages of creative process; from the initial creation of a work, to the final presentation of a composition.

Structured into three distinct chapters, each chapter provides a detailed analysis of an individual composition with the main principles discussed within each chapter relating to my compositional process. Common themes seen throughout each chapter are concerned with granularity, sound sculpting, and spatialization. Through this dissertation I endeavor to provide detailed explanations of each of these techniques and how they are incorporated into my work.

This dissertation is primarily about exploration and intuition. Through unpacking the elements of my compositional practice, I have endeavored to embark on new sonic terrain, situating my work not only within the boundaries and traditions prevalent in Western Art Music, but as an attempt to also expand the compositional dichotomy of acoustic and electronic mediums.

Introduction

For as long as I can recall, I have been fascinated with sound. Discovering new textures, shaping timbre, and imagining new sonic possibilities. I view sound as the driving force of my creativity and compositional practice. I am also fascinated with the ability to capture sound through many different acoustic capacities. Integral to my work is the merging of electronic and acoustic worlds. A continual strive for synthesis in my creative practice, I attempt to incorporate technology in multifaceted ways. The catalyst for this research stems from the desire to extend my own practice as a composer, and to venture into new sonic territories, examining and extending the dichotomy of electronic and acoustic traditions prevalent in Western Art Music. Through analytical and ontological approaches to my work, I attempt to outline the multiplicity of techniques utilized within my practice. Structured in Three Chapters I have endeavored to annotate the processes of my work, detail my approach to creativity and sound sculpture, and make commentary on the inspiration I find through collaborating with performers.

In Chapter One, I discuss my 2019 work *Grit*. A multi-sensorial 15-minute work for piano, fixed media, live electronics, and sound diffusion, *Grit* explores the absolute synergy of acoustic and electronic mediums. The chapter discusses some of the principles the project is preoccupied with, such as, duality, oppositionality, and fragmentation. Detailing the materiality of the sounds chosen, I elaborate on the compositional process I call *sound sculpting*; a practice which I use to formulate the sonic material of both the acoustic and electronic parts. This practice deals with the medium of sound from its discovery, to the process of recording, and finally to the various techniques of electronic manipulation being applied upon it. A special emphasis is given on the technique of granular synthesis whose philosophy and sonic quality is compatible with the conceptuality of the piece and its sonic identity. Additionally, after

discussing and outlining the formal structure of the work, I additionally discuss the importance of spatialization in the work and the ways it is being incorporated.

Chapter Two focuses on my 17-minute sound installation work *Pythmenas* (2019). The sound world of this collaborative work combines the breathtaking sonic data of bowhead whales, ice activity from the artic, and acoustic instruments. Recorded with colleagues at UCSD, through this chapter I discuss elements of the collaboration regarding the formulation of the material, also discussed is the processes of recording and composition in which I enacted through this work. I additionally detail the technical and artistic decisions which went into the creation of the performance patch in the environment of Max/MSP, merging the various aesthetic layers and projecting the resulting sonic experience through the 28 spherically configured loudspeakers of the performance space.

Similarly, to the previous chapters, Chapter Three outlines the composition, collaboration, and sonic processes taken to compose *minute | from within* (2019-2020). Comparatively to the works spoken of in the previous chapters, in this chapter I attempt to emphasize the role of the performer/composer relationship, and the exploration of the unique compositional collaborative approach taken to create this work. Composed for amplified objects and electronics, *minute | from within* explores the minute details of human action through explorations of rhythmic structures and patterns in combination with activated media deriving directly from the performed objects. A juxtaposition of micro and macro sound worlds, I attempt to outline my approach to synergizing tactile sounds against lyrical and rigid melodic lines, and how these creative elements couple against the execution of virtuosic performance gestures. Lastly, I discuss the role of spatialization within the work, and the importance of the concept of *sonic spaces*. Through an emphasis on the minute sonic intricacies of the resonating chambers of

the objects being amplified (the spaces/bodies), I attempt to propose alternative spaces for sounds to exist in and focus on creating a dialogue between the performing musician and the electronics.

Chapter One:

Grit (2019) – for piano, fixed media, live electronics, and sound diffusion

1.1 Objectives:

Grit, for piano, fixed media, live electronics, and spatialization, was composed between 2018 and 2019 for my dear friend and colleague, Dimitrios Paganos Koukakis. It was premiered at UCSD's Experimental Theater on November 14, 2019. For me, I consider *Grit* one of the most representative works of my portfolio to date. Through my explorations and learnings of being a doctoral student, I have seen my work change and develop, with my aesthetic being drawn in many different directions and by a plethora of influences. Through the creation of *Grit,* I begin to feel a change in my compositional output. I have begun to utilize a number of techniques that my work had been concerned with since the beginning of my doctoral studies, however now I attempt to emphasize a shift in my focus to an aesthetic which I feel so passionate about, the synthesis of electronic and acoustic mediums.

My vision writing *Grit* was to construct an electro-acoustic experience in which instrumental and electronic forces are fused and merged, equally contributing to the outcome. The majority of my attempts prior to this work seemed to possess a lack of aesthetic equality between the two entities, with the acoustic presence mainly dominating the composition and being at a more developed level than my electronic output. I was still in an ongoing process of developing my understanding, skills and position within the vast universe of electronic music, whereas my ability to write for instruments had already reached a considerably high level of competency due to numerous years of study and dedication. With *Grit*, I gave special emphasis on the idea of compatibility between the two components, aiming to form a musical situation

where the one depends exclusively on the other, one functions as a means of filtering the other, one is extrapolated into the other, merging worlds.

A work from which I take continual inspiration is Karlheinz Stockhausen's *Kontakte*[1]. Although not a direct aesthetic refence to my work *Grit*, I take motivation from the way the repertoire manages to fit instruments and electronics in the same context so organically and with such intuition. There is a particular segment, from the middle of the composition, in which activity accumulates into the absolute marriage of the material of the tape and that of the two instrumental parts. The segment exists in between the time markings 17'05'' and 17'55'' as indicated in the score. At the very beginning of the excerpt mentioned above, the tape exists alone. Impulse generators are used to produce a grating steam of sounds that follow an elaborate contour, during which the pitch content is shifted over a wide frequential band, while the speed of activity is decreased. This continuous and linear distribution of sound is gradually being transformed into a succession of sharp percussive attacks that seem to simulate the sound of woodblocks. These attacks, then, go through a second phase of a transformative process where, on one level, envelope generators come to play, reducing the sharpness of each individual event, and, on a second level, reverberation is added to thicken the body and reinforce the sonic presence. Through the application of these techniques, the sonic imagery of hitting woodblocks is being morphed into the auditory illusion of hammers hitting strings inside the piano. Consequently, this process results in an ever-slowing accumulation of frequential presence, and, more specifically to a particular pitch, the note E3 (below middle C). The emergence of this pitch signals the cue of the instrumental forces to join and articulate the same exact pitch. Peter Manning refers to that moment of *Kontakte*, observing that "the resultant merging of timbres

[1] Stockhausen, Karlheinz. 1976. *Kontakte: elektronische Music, Nr. 12.* London, UK: Universal Edition.

providing perhaps the most poignant point of contact in the whole work."[2] Fascinated with this particular moment within the work, I took inspiration from this sonic moment, and that helped form some of my elemental experiments and ideas going into the construction of *Grit*.

Additionally, another element I was preoccupied with during the conception and construction of *Grit*, (and also an element that has found application in many of my previous works) is the idea of oppositionality. Within this concept, I am interested in how a particular musical experience presents and coexists with others. Focusing on two distinct aesthetic or technical elements, my main outcome with this concept is to track and explore journey of two different scenarios over the course of the work. For example, the use of dynamics harmoniously co-existing, cooperating, accompanying each other, yet still arguing and struggling, the relationship of tension and release. In the case of *Grit*, the two protagonists appear as the concepts of continuity and fragmentation. Their relationship becomes apparent with the way that the work attempts to define and construct its sonic materiality and form. The nature and quality of the electronics, the relationship between the acoustic and electronic means, and the spatialization trajectories projected through space all encapsulate a back-and-forth dialogue of division and yet a defiant permanency. The co-existence of the two creates an elaborate and intricate interplay in the narrativity of the musical work, and I feel that the combination of this dichotomy adds substantially to the dramaturgy of the experience.

From a philosophical standpoint, this relationship can be tied, in general terms, to the ideal of *dualism* presented initially by the Ancient Greeks and explored further by philosophers

[2] Manning, Peter. 2004. *Electronic and Computer Music*. New York, NY: Oxford University Press, p. 66

like Descartes[3] and Hume[4] later in the 17th and 18th centuries. A term introduced by Plato, it was used to examine the dualistic aspect between the mind and the body, classifying the former as of greater importance and the latter as ephemeral.[5] Aristotle followed to challenge Plato, underlining the aspects of co-dependency and total union as essential for the ultimate functionality of the system in which they interact. Throughout the history of music, the notion of duality can be seen as a key feature in various instances; from the binary forms in the baroque era, to building the entire infrastructure of the sonata form based upon two thematic entities, all the way to dealing with the ideas of contrast and extremities in the 20th and 21st centuries. For my work, I am drawn to the position stated earlier in reference to Aristotle, one in which I take into consideration when setting the ground to define the dualistic facet in my artistic contexts.

Additionally, to the work of Stockhausen, when approaching the initial stages of *Grit*, I also drew inspiration from Edgard Varése's *Poème Eléctronique*[6]. A work that I believe immerses itself with contrast of entities and implements oppositionality between continuity and fragmentation, the grandeur of this phenomenon can be identified right at beginning of the piece. One can hear what sounds like a low-pitched gong being struck, filling the auditory space with its resonances and long natural delays. This elaboration of continuous sound is quickly contrasted by a fragmented scene consisting of a series of dry attacks in regular and irregular rhythms, at various amplitudes and rates of decay. These percussive attacks are then immediately substituted by multiple sustained sirens, ascending and descending in pitch and amplitude.[7] As

[3] Baker, Gordon; Morris, Katherine J. 1996. *Descartes' dualism.* London, UK; New York, NY: Routledge.
[4] Flage, Daniel E. "Hume's Dualism." *Noûs*, Vol. 16, No. 4 (1982), pp. 527–541. *JSTOR*, www.jstor.org/stable/2215205. Accessed 08 Sept. 2020.
[5] Robinson, Howard. 2020. *The Encyclopedia of Philosophy*. "Dualism".
[6] Varèse, Edgard. 1958. *Poème électronique.* Royal Concertgebouw Orchestra, Asko Ensemble, Riccardo Chailly. Released on January 1, 1998. Produced by Andrew Cornall. *Varèse - Concertgebouw Orchestra, Asko Ensemble, Riccardo Chailly – The Complete Works*. Decca Music Group Limited. 460 208-2.
[7] Ouzounian, Gascia. 2007. "Visualizing Acoustic Space", *Circuit: musiques contemporaines*, Vol. 17, No. 3, p. 51

Gascia Ouzounian points out "In *Poème électronique*, oppositionality is manifested as extreme contrasts in frequency, register, amplitude, consonance, duration, rhythmic regularity, multiplicity of voices, location and movement of sounds in space, and the rate of change of all of these."[8] All of the elements which Ouzounian outlines within the above quote, are all elements in which I have attempted to apply and have acted as inspiration within the compositional process of my work *Grit*.

1.2 Materiality:

My approach towards the formulation of material for both the acoustic and electronic components of the work were preoccupied with the afore-mentioned principle of oppositionality, and, thus, I attempted to create sounds that serve the concepts of continuity and fragmentation. One simple method I followed to achieve this goal was working with the idea of resonance, and resonance being juxtaposed against rhythmical complexity.

Additionally, another concept I focused on when building my sonic palette was to present different timbral qualities that would intermingle and create dialogue throughout the course of the composition. In my aesthetic opinion, the piano could not be a better medium for this endeavor as it is an instrument that produces an immense body of sound (an element that provides automatically a vast spectrum of sonic combinations and possibilities), one in which I saw the potential for two unique functionalities in which I wanted to explore. These being the pianos main pianistic (and perhaps 'traditional') capacity, and a further potential for percussive exploration. In an effort to sonically elaborate further on these ideals, I explored the possibility of incorporating small percussion instruments to be placed on parts of the piano that would be within the area of the pianist's reach. Another significant point that was taken into consideration

[8] Ibid.

with regard to the location of the percussion instruments, was an attempt to identify the most ideal spots in which each strike would excite resonance from the body of the piano with the assistance of the sustained pedal.

Furthermore, the inclusion of the extra instrumental forces (percussion), offered my work a deeper and more thorough investigation into achieving and discovering sonic profiles that I feel represent the change in aesthetics which I am trying to articulate with my composing throughout the last few years. In *Grit*, my writing is focusing on the construction of evocative and eccentric gestures, coupled with the formulation of fragile and vulnerable timbres, achieved via the application of multiple layers of extended techniques. Combining the broad span of sonic capabilities of the piano with the expressiveness of the percussive elements, I feel this new preoccupation with percussion provides me with opportunity to enhance the friability and malleability of my textural agenda, as well as to discover new gestures.

As stated previously, my aim towards the electronic presence in the work was not to exist as a separate entity with purely distinct material, but rather to embrace, filter, and expand the sonic properties presented by the instruments used. To develop a cohesive partnership of the two forces. The mentality towards the unification of the two forces echoes Luciano Berio's view on electronics and their role in his work. To quote Berio, "I regard experience of electronic music as very important precisely because rather than opening the door to the discover of "new" sounds it proved the possibility of a definite outcome of dualistic conceptions of musical material and gives the composer the practical means of integrating in a musical thought a larger domain of sound phenomena viewed as segments of the sound continuum."[9] Therefore, in an effort to establish further this co-depended relationship between the two domains in my work *Grit,* I

[9] Berio, Luciano. Liner notes, *Electronic Music* (Turnabout, TV 34046S, 1966, New York)]

approached the electronic component in two distinct ways. Firstly, I recorded sounds that were produced exclusively by the instruments the project employs (i.e., piano and percussion), secondly, I implemented at times signal processing techniques to reinforce and modify the instrumental part in real time. I feel through using this technique, I have achieved a way to combine the acoustic palettes of the work, creating a sonic foundation in which I can further develop additional compositional concepts; concepts that are heavily situated within the sonic realm created by the merging of the electronic and acoustic frameworks of the piece.

1.2.1 *Sound Sculpting*:

To build the material of *Grit*, I began with the construction of the fixed media component, utilizing the process I call *Sound Sculpting.* Within my practice of *Sound Sculpting,* assembling the electronic media consists of three main stages (which I will outline below). It is worth mentioning here that, regardless the forces I work with in my projects, acoustic or electronic, I give special emphasis on the utilization of acoustic instruments or found objects for the production of musical material. Thus, the process starts with the instruments themselves on the first step I have entitled *Sound Discovery.*

1.2.1.1 Stage 1: *Sound Discovery*

In the *Sound Discovery* stage of creating *Grit*, I went through lengthy explorations of sonic possibilities, experimenting on my own on the prepared piano on the 3rd floor of the Conrad Prebys Music Center at UCSD. This personal journey of discovering sounds creates the circumstances for building a more intimate relationship with the body of sound I work with. Especially due to the fact that I do not possess the ability to properly play the particular instrument from the traditional point of view, this process helped me gain an even better understanding of the mechanics of the piano, and I had the possibility to obtain from very close

proximity a sense of all the resonances produced by the sounds I was going for. Throughout this process of experimentation, keeping a log of activity and documenting every moment with thorough notes are of immense significance for the ongoing stages, as well as for the entirety of the process of *Sound Sculpting.*

With the concept of 'resonance against complexity' in mind, the first step I took while experimenting on the piano was the examination of numerous sonorities / chords. With no particular pre-conceived harmonic plan, I proceeded to the process quite intuitively, while writing down all the chords that intrigued my ears. Contrast was another element I was considering. Firstly, I was attempting various formulations of chords that were proposing different intervallic structures. Secondly, I was going for extreme antithesis with regard to the location in the spectrum in which my sonorities existed, both within the chords themselves and via registral differentiation between adjacent chords.

Furthermore, aiming to achieve a plethora of timbral profiles, many external objects were used to prepare the piano with. For instance, I initially considered to make use of mutes that would be attached to the strings of specific pitches inside the instrument. The application of the mutes would function as a form of filter, muffling the resulting sound by strengthening the attack of the note while attenuating its decay. Another object that was incorporated in this process was a 12" x 8" metal rack. The item was placed on the lower strings of the piano with no specific way of attaching it solidly on them, and I started hitting individually the notes of that specific registral area. The energy produced from the vibration of the string would be transferred to the body of the rack, which would correspondingly vibrate, adding, apart from a metallic tone, a quite prominent level of fragility to the spectral profile of the outcome.

Exploring further the idea of timbral differentiation and plurality, I expanded my bag of tools with objects with which I could also produce pitch orientated sound, as opposed the more 'noise' orientation experiments detailed above. I experimented with different materials (e.g. metal, plastic, wood, rubber), however my initial experiment was with coins. With two heavy coins, one in each of my hands, I started hitting strings inside the instrument, both individually and in various combinations. With this quite unique timbre, I was seeking to get a variety of sustained resonances, but I was also creating situations with a randomized pointillistic quality, implementing complexity of rhythms and contrast in amplitude. Similarly, a short and thin chain was used to perform the same techniques, both on the strings and on the pegs. I discovered that with the chain, as opposed to the coins, the resulting sound ended up portraying a sense of vulnerability, as not all the points of contact were controllable due to the asymmetrical geometry and limited thickness of the object.

In additional to metal utensils, I also experimented with plastic materials in the form of a long ruler and a thick guitar pick. By placing the ruler vertically in between strings, I proceeded with a process similar to a "sawing motion" on the strings in a variety of rhythmical patterns. The instrument I was working on could not be a better choice for that technique, especially on the strings of the middle registral area. Due to the extensive use of the instrument, but also the use of a variety of non-traditional techniques applied on the strings over the years, rust had been grown on their surface. That element added a grainy quality to the outcome that I found quite fascinating, matching the timbral identity I was initially envisioning while conceiving the project. Similarly, the pick was used to scrape the strings of the lower register, exciting resonances were produced with a sole strike and I found that these short segments produced

intense sonic activity. The same grainy effect was apparent here, as well, due to the extensive thickness and the gritty texture of the strings of the particular registral area.

Lastly, I experimented with objects made of wood and rubber. For instance, wooden pencils were also included in my box of external tools. The way I produced sound was by dropping the pencils on random places along the strings, resulting in a succession of hits that were gradually attenuating in amplitude as the object was bouncing until stopped. That event created an interesting effect that would simulate the element of fragmentation. In addition, another object that was deployed were wooden clogs. Wooden clogs were attached again to the strings of the lowest register and by hitting the associated keys the resulting timbre had a muffled and thudded quality, simultaneously overpowering the body of its attack while eliminating the decay. With regard to rubber material, superballs were utilized in various places of the instrument (e.g. the body, both internally and externally, and the strings) by sliding the object with different amounts of pressure along the surface aiming to create friction (as would be seen with a percussionist playing a superball), a phenomenon that also incorporates the elements of fragility and granularity as well as continuity.

1.2.1.2 Stage 2: *Sound Recording*

After having completed an extensive series of experimentations, akin to a child in a candy store, I felt confident and satisfied with the results and was ready to proceed to the second stage of my *Sound Sculpting* process, in which I entitle, *Sound Recording.* Before initiating this process, I spent some time to make a shortlist of the events that I felt strongly about and that I could see would work in the context of the piece. This second stage is the least extensive and it features the audio recording of all the shortlisted events.

Recording not only has the ability to capture sound in a range of acoustic capacities, but it also provides a tactile quality that facilitates my creativity, setting the ground for the next step in the process, the process where the recordings are being electronically transformed. Recording also enables me to go back to my material, the beauty of this cyclic approach to discovery enables me to re-tune my memory of its first moments of existence, re-examine, and re-define it.

For *Grit*, apart from recording the sounds I discovered on the piano, I wanted to expand my sonic palette with sounds that would serve the vision I had about the percussive dimensionality of the project. I had the privilege to collaborate with my colleague and doctoral student in Performance at UCSD's Music Department, Rebecca Lloyd-Jones, who assisted me on the recording of sounds on percussion instruments. For that side of the material, I was seeking to record mainly straight-forward percussive sounds. We ended up utilizing only various types of drums –that is, bass drums, snare drums, toms, congas, and timpani. Something which captured my ears was a set of woodblocks. I recorded this set of five woodblocks individually and with three distinct types of activity: single hits, regular tremoli (with both steady and fluctuating amplitude), and rhythmical irregularities (with both steady and fluctuating amplitude). My intention to incorporate this type of material in my palette was to initially establish and strengthen further the concept of attack. In juxtaposition to the attack of the woodblocks, I also envisioned pairing the fricative color of the superball effect I had implemented on the piano, similarly experimenting with the different sizes of superballs producing similar sonic color on the skin of the drums. After the recording process, all the audio files were included in a library where they were given names based on the type of activity they represent and the way they were produced.

1.2.1.3 Stage 3: *Sound Manipulation*

The subsequent stage of *Sound Manipulation,* as outlined in steps below, focuses primarily on the electronic component, and involves a broad array of techniques I have been experimenting with for years involving the temporal, dynamic, frequential, timbral, and spatial dimensions of my ideas.

• Normalization:

Before getting to the transformative step of the sound, there are three basic procedures that take place. The first procedure involves simply the isolation of the sonic profiles I am interested in including fades at the outer parts. Then, I proceed to equalizing the dynamic parameter, normalizing the amplitude to -3dB for every sound.

• Noise Reduction:

Following the normalization, I begin to remove any external noise that may have been present in the recordings, reducing any hiss component in the spectrum to about -15dB and, consequently, boosting the energy of the desired signal.

• Temporal Modification:

After having normalized and cleaned my sounds, the main part of this stage of *Sound Manipulation* is initiated. The two main components of my sounds that go through the most extensive transformative process are the temporal and the frequential. With regard to temporal transformation, I deal with three distinct techniques; speed modification, looping, and reversal/inversion. In the speed modification category, there are three approaches being taken into consideration; the first one applies speed change that remains constant throughout the course of the sound, while the other two implicate the features of acceleration and deceleration. The

looping technique usually focuses on specific segments of the audio file that are being repeated for a certain number of times. Finally, with the reversal/inversion technique, the audio files are played backwards.

• Frequential Modification:

Furthermore, the frequential aspect is being modified by the application of the pitch shifting technique, where the pitch of the sound is being raised or lowered. Similar to modifying the speed, the parameter of pitch may undergo a gradual process of transformation, ascending or descending over a period of time.

• Timbral Modification:

Other components that are being modified include the timbral and the spatial. In the former, various filters are pertained to change the formation of the spectral image of the sound by attenuating parts of the spectrum and, consequently, reinforcing others. The basic four filters are the *high-pass*, *low-pass*, *band-pass*, and *band-stop*. The *high-pass* filter attenuates all the frequencies below the specified cutoff frequency, while the *low-pass* attenuates all the frequencies above it. On the other hand, in the *band-pass* filter, all the frequencies within the specified part of the spectrum pass, and the opposite occurs with the *band-stop* filter, which passes all the frequencies outside the band.

• Spatial Modification:

Furthermore, the element of reverberation is being added to modify the spatial dimension. Several parameters are taken into consideration while experimenting with applying reverberation to the body of a sound, and these include the shape and size of the space it exists, the space's convolution profile, and the frequential sensitivity.

• Granular Synthesis:

The contribution of the technique of granular synthesis to the overall project is significant due to the quality of fragmentation inherent in its nature. I am fascinated by the process of granular synthesis as this technique breaks down the audio signal down into small grains. A grain of sound is a brief micro-acoustic event, with a duration near the threshold of human auditory perception, typically lasting no more than 50 milliseconds. The notion of breaking up the audio spectrum into minute grains of acoustic quanta was first proposed by Hungarian physicist Dennis Gabor in 1947.[10] This concept was in contrast to traditional wave theory supported by Fourier analysis of frequency cycles, which regards the signal "sub specie aeternitatis".[11] Gabor developed a mathematical principle for representing sounds as being composed of minute grains, each with its own waveform, envelope, duration, density, and position in space.[12] He stated, "sound has a time pattern as well as a frequency pattern."[13] One of the first composers utilizing the technique was Iannis Xenakis, who in his essay *Formalized Music*, writes "All sound, even continuous musical variation, is conceived as an assemblage of a large number of elementary sounds adequately disposed in time... In the attack, body, and decline of a complex sound, thousands of pure sounds appear in a more or less short interval of time, Δt."[14]

According to Curtis Roads, based on the way grains are organized in time, groups of grains are being identified as either *streams* or *clouds*. In *streams*, grains are allowed to be modified predictably over time, following each other in fixed delay times, whereas in the *cloud* model the grains are randomly or chaotically distributed in time. In the event of the former, the

[10] Manning, Peter. 2004. *Electronic and computer music*. Oxford; New York, NY: Oxford University Press. p. 391
[11] Gabor, Dennis. 1952. *Lectures on communication theory*. Cambridge, MA: The MIT Press.
[12] Holmes, Thom. 2016. *Electronic and experimental music: technology, music, and culture.* New York, NY; Abingdon, Oxon: Routledge. p. 352
[13] Gabor, Dennis. 1947. *Nature.* "Acoustical Quanta and the Theory of Hearing". Vol 159 (4044), p. 591
[14] Xenakis, Iannis. 1992. *Formalized Music: thought and mathematics in composition.* Pedragon Press, p. 43

main parameter that is being modified is that of frequency, generating pitched sounds within specific bands through spectrum analysis, filtering, and enveloping. In contrast, the attributes of grain density, grain duration, amplitude envelopes, frequency bands, and grain spatial dispersion may vary within the overall duration of the cloud.[15]

In *Grit*, I worked with the granulation object *munger*[16] on Max/MSP. Having been utilizing *munger* for a number of years, I have managed to advance my level of operation in it, manipulating the several parameters to the degree that serves the purposes of each individual project. In *munger*, I see the sets of instructions being divided into two main categories. The *First Order*, containing all the macro-level parameters that remain constant every time the engine operates, and the *Second Order*, consisting of the micro-level parameters that I tend to modify in real-time during the performance.

<u>First Order:</u>

- *Ramp Time*: Sets the length of the ramping envelope on each grain in milliseconds. (If grain size is smaller, ramp time will be scaled to half the grain size.)
- *Position*: Sets the playback position within the buffer.
  Scale 0-1 = positions within the buffer
  -1 = randomized
- *Grain Overlap*: Sets whether the grains overlap or are consecutive.
  0 = Consecutive
  1 = Overlap
- *Ambidirectional*: Allows grains to play backwards and/or forwards.
  0 = Backwards and Forwards
  1 = Just forwards
  -1 = Just backwards
- *Gain*: Sets the baseline gain for grains.
  Scale 0-1
- *Scale for Pitch Variation:* Defines the width of spectrum to which pitch may vary

[15] Roads, Curtis. 2001. *Microsound.* Cambridge, MA: The MIT Press, p. 88-91
[16] Developed by Dan Trueman. Department of Music, Princeton University.

Second Order:

- *Maximum Length*: Sets the maximum length in milliseconds.
- *Voices*: Sets the number of grains to be allowed simultaneously.
- *Grain Delay Time:* Sets the duration between to consecutive grains in milliseconds.
  - Grain Delay: Time between grains
  - Grain Delay Variation: Width of time between grains
- *Grain Duration:* Sets the duration of each grain in milliseconds.
  - Grain Length: Fixed grain duration
  - Grain Length Variation: Width of time for grain duration
- *Grain Pitch*: Sets the location of transposition in the spectrum
  Every integer, with 1 being the fundamental, sets the next harmonic in the series, and the intervals in between are accordingly divided in 100 cents.
  - Grain Pitch: Transposition
  - Grain Pitch Variation: Width of spectrum for transposition
- *Spatial Dispersion in Stereo Domain*
  - Grain Pan Spread
    0 = Center
    1 = Spread across the stereo field

After lengthy experimentations with the machine over the years, I believe I have found a platform which provides agency to the projects I have been working on and also matches the aesthetics they represent. Working mainly with the model of *clouds* of grains, I am interested in the randomization of processes offered by *munger*. First of all, with the input of the value "-1" for the *Position* parameter, the exact location in the buffer, from which grains are extracted for reproduction, is left upon the machine. The same logic is considered for the aspect of the *Ambidirectional* element of the platform, instructing the machine to randomly choose the direction with which the grains are to be played back, forwards or backwards. In addition, I allow the spread to occur randomly throughout the space across the stereo field, while the amplitude, with which all grains are projected, remain constant. Finally, aiming to utilize the

munger object to highlight further the element of fragmentation in my projects, the grains are laid out consecutively, one after the other, with no overlap.

Table 1.1: The *First Order* Parameter Values

Ramp Time	**25**
Position	**-1**
Overlap	**0**
Ambidirectional	**0**
Gain	**1**
Grain Pan Spread	**1**
Scale for Pitch Var	**0 1 -1 2 -2**

One of the most essential aesthetical decision made in the infrastructure of the object has to do with the width of the frequential spectrum allowed for the grains to exist when pitch is varied. As Table 1 shows, the scale applied for the *Pitch Variation* parameter is "0 1 -1 2 -2". Each number indicates the distance in semitones from the fundamental (i.e. 0). In this case, the spectrum the machine is allowed to cover spans from 2 semitones below the fundamental to 2 semitones above. Now, the value with which the *Pitch Variation* parameter works ranges between 0 and 1. Having 5 numbers in the scale, the width 0-1 is automatically divided into 5 equal parts, and each part translates into the number of pitches allowed according to the orderly fashion of the scale. As an example, with the fundamental being the pitch C4, if setting the *Pitch Variation* parameter with the value "0", the only pitch heard from all the grains will be C4. Setting it to "0.25", the pitch C#4 will be added in the possible reproductive pitches, together with the fundamental. Similarly, if the parameter reads "0.75", then the frequencies heard will be C4, C#4, B3, and D4.

Munger played vital role in the *Sound Manipulation* stage of the *Sound Sculpting* process. The way I proceeded to the use of *munger* for transforming my sounds was through the formation of distinct presets.

Table 1.2: Examples of Presets Used in *Munger*

Preset # →	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Max Length	250	700	1000	3000	1000	3000	1000	1000	3000
Voices	5	10	20	20	10	5	10	10	20
Grain Delay	0	50	0	10	0	50	0	0	10
Grain Delay Var	0	0	0	80	0	0	0	0	80
Grain Size	50	150	150	120	300	800	200	300	120
Grain Size Var	25	50	50	10	100	300	100	50	10
Grain Pitch	1	1	1	0.75	0.5	0.25	0.375	1	1
Grain Pitch Var	0.75	1	0.5	0.25	0.5	0.75	0.25	0	0

One example of the application of *munger* for the manipulation of recorded data can be found at the second system of Page 8[17] of the score. Presets #2 and #3 have been utilized consecutively in the audio files activated in cues #39[18] and #40, respectively. The recorded sounds transformed here were different fragments of sonic activity produced on the pegs of the instrument with the assistance of a metal chain. Preset #2 was applied to the shorter of the two fragments, extending its overall duration by 700ms and extracting grains that were laid out in 10 different voices with size ranging from 100 to 200ms. The parameter of pitch is unchangeable throughout the transformation. Taking the process further, Preset #3 doubles the number of voices to 20 and enlarges the length of the processing time to 1000ms, while the grain size remains constant. The process also opens up the pitch content range by one semitone on both ends, and, most importantly, eliminates the presence of any gaps between the grains. We can say here that the latter moment is a developed version of the first, where an even more extensive use of the object adds complexity to the dimensions of pitch, rhythm, and time. This instance in the

[17] Throughout this chapter, score page numberings refer to the page numbers in the score of *Grit* attached as Appendix #1.
[18] Throughout this chapter, cue numberings refer to the cue numbers in the score of *Grit* attached as Appendix #1.

piece is a great example of the powerfulness of *munger* as with the same sonic profile, it manages to create differentiation and provide a sense of momentum to the musical course.

Furthermore, another stimulating manifestation of the granular quality appears in cues #34 and #49 with the implementation of Preset #5. Activating cue #34, two audio files are projected in the space with the one being the processed version of the other. The effect with the chain hitting the strings of the instrument is heard again here. The electronic process produces fragments of a variety of durations (i.e. between 250-350ms) resonating an octave lower from the fundamental with the addition of the intervals of 9^{th} and 11^{th}. The intention, besides expanding the textural agenda of the sound itself, was to create an illusory situation that would perfectly intermingle the sound of the hitting pencils in the piano part with the sound of the tape, making any differences indistinguishable. In addition, in cue #49, Preset #5 was applied upon the recorded sound of regular tremoli on two woodblocks. The pitch shift along with the broken continuity provided by the granular synthesis purpose to imitate and, thus, organically set the ground for the timbral quality and rhythmical narrative of the activity that rises in the piano part, where two mallets hit the bars of the instrument.

Apart from its assistance in the transformative process of the fixed media, granular synthesis made itself a vital aspect processing the signal of the piano in real time during the performance. At three instances I made use of the *munger* object; in cues #13-17, #29-30, and #34. In the latter, I was willing to establish a stronger connection between the timbral character of the piano and the one that is projected with the audio file in cue #35. Preset #9 is triggered to dismantle the figuration of the repeated notes at the end of the segment, while the electronics rise from underneath. With the nature of this process, I was not seeking to transform the parameter of pitch in any way, therefore I kept the *Grain Pitch* in "1" and zeroed the variation component,

while I reinforced the fragmentation aspect by widening the gaps between the grains through the delay parameter. In cues #29-30, *munger* initiates Preset #7 right before the piano starts resonating the pitch Ab2. Preset #7's main purpose is to broaden the body and, thus, strengthen the presence of this unique textural profile of the bowed string by adding subharmonics, transposing the signal to one octave and an augmented 4th lower, to D1, with the inclusion of the Eb1, as well.

• Additive Synthesis:

In *Grit*, the majority of the sounds comprising the fixed media component have undergone additive synthesis via the application of various of the afore-mentioned techniques. In an effort to extend the coloristic characteristics of each sound's identity as well as add complexity to its presence, this process fundamentally purposes to highlight the project's original vision for the nature of the electronics, that is to compliment and expand the sonic capabilities of the instrumental forces. The synthesis also aims to contribute through the electronic domain to the further establishment of the two main entities the work engages with (i.e. continuity and fragmentation).

A characteristic example of additive synthesis presents itself with the first sound heard in the work. The sonic profile it conveys as originally recorded is that of dropping a pencil on the strings to bounce until stopped. After isolating a minute segment of 3" involving the object articulating 3 separate hits, the segment went through a modification procedure of its temporal and frequential components. It was pitch-shifted two octaves lower and stretched to an additional 60% of its original speed, ended up lasting for 8". Continuing synthesizing the material, the last edit was further processed by the *munger* object's Preset #9. By importing it into the granulator, my purpose was to, firstly, multiply the number of attacks incorporated in the original segment,

adding 20 more voices of grains. Secondly, through the randomization of projecting grains of various lengths, I distorted further its already fragmented nature. One final step of manipulation occurred with modifying the temporal aspect, by stretching, not the speed, but this time its tempo to another 60%. Through this procedure, all the grains underwent further granulation and a gesture that initially laid out only 3 attacks ended up being formulated to an expansive musical phrase that consists of dozens of minute strikes.

Other sounds that were applied various layers of editing techniques were those of the chords –and their resonances– recorded on the piano. For instance, the upper waveform image as shown in the score in cue #4 represents the reversed version of that type of sound. Apart from the reversal procedure, the attack of the particular chord has been cut out. However, although the attack has been eliminated from the audio file, the same sonority is stroke by the pianist at the beginning of the gesture in cue #5. In addition, the edited audio was further processed by *munger* and Preset #8. Keeping the pitch content unchanged, the process adds several dynamic peaks during the evolution of the sound, peaks triggered by the individual grains. My goal here was once again to dismantle the element of continuity the sound originally carried and, thus, provide to it a sense of fragility.

Overall, my approach to *sound sculpting* is influenced by an intuitive process through which the evaluation of the final product is dictated by my own ears. If the outcome is on any level unsatisfactory, the process returns to previous steps for re-examination, re-application of processes, and re-evaluation. This reflective and purely visceral attitude towards sound editing echoes sound artist Martyn Ware, who, when describing his method, explains that “Conceptually I usually work alone in my studio—primarily in my meditative/lucid dreaming mode—I believe strongly in following my subconscious, and trying to interfere as little as possible with the

intuitive flow of ideas."[19] Through my exploration process, I attempted to engage as intuitively as possible with the material and processes in which I was fortunate to experiment with.

1.3 Structure:

The process of structuring *Grit* was initiated by organizing the fixed media in time, and after having a clear picture of the global shape of the piece, the process of writing for the instrument occurred and was applied upon the electronic component. This process proved to be beneficial for the aspect of being able to experience in real time the succession of events and feel the flow of the work while writing, a phenomenon not possible, to that extent, with purely acoustic music. Pierre Schaeffer, the pioneer and representative of the practice of *musique concrète*[20], considered the process of active listening of the material as quite essential for the understanding and realization of the form of his music. Daniel Terrugi comments on Schaeffer; "To prove the potential of recorded sounds, he started combining and assembling them in sound structures, which he called "études" or experiments on different types of sound sources and combinations. The result of these experiments he called *musique concrète*, defining though this expression the situation where, through concrete listening to sound material, the composer creates the musical structure, in opposition to traditional musical writing, in which the abstract creation of the composer on the score leads to the concrete listening situation of the performance".[21] I draw inspiration and comparison from this mode of listening, as through *Grit*, I attempted to embark on a new journey and process of composition, one which saw me take on a

[19] Hugill, Andrew. 2019. *The Digital Musician*. 3rd Edition. London, UK; New York, NY. Routledge. p. 95
[20] Schaeffer, Pierre. North, Christine and Dack, John, translators. 2017. *Treatise on musical objects: An essay across disciplines.* Oakland, CA: The Regents of the University of California.
[21] Ibid., p. xvi

more involved approach to designing the sonic and notated components, more than in my previous works.

As stated earlier, the premise of the piece was orientated around the concept of duality and oppositionality between the ideas of continuity and fragmentation, and this concept is again apparent with the way the piece is structured. The approach followed for the construction of the work's form was via building a framework of a number of successive sections and events, of which the nature of the activity would alternatingly support the ideals of the two entities mentioned above.

A. Fragmentation [Page 1 – Page 2 till end of first system]

Alternating short fragments of electronic and instrumental activity, the intention here is to present a scenario that the two are in a constant dialogue, debating, without either dominating at any point. The pianistic writing includes various techniques that are being executed inside the instrument, providing at the beginning a sense of the sonic palette the piece works within. During the section, moments of continuity are being elaborated to serve the anticipation of the phrasal momentum, being though abruptly interrupted. Examples of this phenomenon can be heard in the electronic cues #4 and #7 with the modified audio files of recorded resonances.

B. Continuity [Page 2, second system – Page 4]

This section presents a contradictory landscape to the introductory one. The feeling of continuity is being achieved here by the fact that the two forces seem to have a more harmonious relationship, accompanying each other, overlapping one another, as well as giving space and time to each other to present their material. In this section, the piano primarily elaborates a rhythmical activity, alternating strikes between the drum and the tile, both placed inside the instrument. This element of this section portrays a notion of fragmentation that is further

amplified by the activation of the *munger* object that picks up the signal, processes it in a number of ways, deconstructs it, and diffuses its individual pieces in space. At times, the piano comes to terms with the electronics reinforcing the grainy and sustained quality of the modified superball sounds by utilizing the same technique on the body of the instrument, exciting more resonance to the space.

I consider the ending of this second section (more specifically, the end of the first system and the second system of Page 4) functioning as both a coda of the first occurrences of the two landscapes (i.e. A and B) and a bridge to the next part. This short part purposes to decompress the level of intensity that preceded. Therefore, only one of the elements performs alone (i.e. the piano) with quite subtle and gentle musical action incorporating in between phrases relatively long moments of inactivity, giving both the musical narration and the listener the opportunity to breathe.

C. Fragmentation [Page 5]

Here the level of intensity is elevated in comparison to the first fragmented section (i.e. A). The duration of the fragments is reduced, while rhythmical and timbral complexity is added overall. The electronics activate media that each is comprised of layers of individual audio files merged together, and the keys have a more prominent role in the piano part, which consists of faster and more rhythmically elaborate gestures.

A series of repeated notes with their strings muted bring this section to a closure, while underneath the intense and complex property of the electronic event in cue #29 arises a quality that ties back to section B – a stretched and pitch-shifted superball gesture.

D. Continuity [Page 6]

Similar to section B, the intention of this section is to lay out continuity of fricative activity. A quite unique textural color is being presented in the piano part, where two batches of hairs are used and placed to bow the strings of distinct pitches. The first batch is used to resonate the pitch Ab2, which has just been already introduced by the preceded audio file in the electronic part in cue #29. In the part where the second batch is being brought into play, the tone of complexity in the harmonic and spectral aspects is reinforced as two adjacent notes, D2 and Eb2, are heard together. Seeking to match the timbral character of the sonic profile demonstrated in the piano part, the audio files of this section employ pitch-shifted sounds of superballs dragged along surfaces of drums. In addition, live processing of the signal occurs, implementing again the *munger* object, scattering the multiple fragments of the pitch-shifted activity in time and space. The interplay of the two forces continues with only the departure and arrival points of the individual phrases of the two parts to overlap in an effort to settle the level of intensity accumulated in the previous section.

E. Fragmentation [Page 7 – Page 9, first system]

Another fragmented environment is being laid out here, reaching a peak point in complexity in the dimensions of timbre and rhythm.

First of all, pencils are being added in the picture with brief figurations of hits and scrapes on the strings of the instrument interrupted by short phrasal segments played in the keys. The two, pencils and keys, come eventually to co-exist in the same context as the level of action is gradually being intensified by the beginning of the first system in Page 8. In the electronics, the sounds produced by the chain in the piano are heard in various transformations in cues #34-37, aiming to present an accompanying timbral color to the resulting sounds from the pencil hits.

The arrangement of the separate phrases between the two forces presents an overlapping attitude that contrasts the strict abruption observed in the previous sections of fragmentation. The phenomenon sets the ground for the upcoming combinatory section, which makes equal use of the two principles as well as creates a scenario with the two forces (i.e. piano and electronics) operating organically together.

F. Combinatory 1 [Page 9, second system – Page 11, first system]

Both principles of continuity and fragmentation are taken into consideration for this section in its entirety. The piano, being the main protagonist in the section, makes use of solely the keys to build an infrastructure of an elongated linear trajectory. It constitutes short fragments that undergo gradual expansion in duration and intensification in rhythm. The electronic part works with processed sounds of rhythmically regular and irregular tremolos in different drums.

G. Combinatory 2 [Page 11, second system – End]

Similar to the previous section, this final part of the work considers again to establish both principles, though in a different way. This section's landscape consists of numerous brief segments of different musical activity. Even though the narration seems to be scattered, continuity prevails itself through the harmonious cooperation between the forces in each one of the fragments, but also through gradually releasing energy and reducing intensity as the piece approaches the end.

1.4 Spatialization:

I consider space to be an integral parameter in which my practice is seriously invested. My approach to space echoes Edgard Varèse's statement that reads "We have actually three dimensions in music: horizontal, vertical, and dynamic swelling or decreeing. I shall add a

fourth, sound projection – that feeling that sound is leaving us with no hope of being reflected back, a feeling akin to that aroused by beams of light sent forth by a powerful searchlight – for the ear as for the eye, that sense of projection, of a journey into space."[22] The main objectives of *Grit,* which I have previously outlaid, (the relationship between continuity and fragmentation) are also implemented into the construction of the dimension of spatialization.

In *Grit*, I worked with two main types of spatial motion. Influenced by Trevor Wishart's research on the topic[23], I distinguish the two types as *direct* and *irregular.* In *direct* motion, the sound moves continuously in space without changing direction. In contrast, I define *irregular* the movement whose directionality is interrupted, thus, changing departure points during the course of the sound that follows, not trailing a direct route. A combinatory approach is also considered, where parts of a sound travel with *direct* motion, while in other parts the sound scatters itself jumping to different locations.

The dimension of spatialization in *Grit* was constructed and implemented in a Max/MSP patch, utilizing Ircam's software suite *SPAT5.1*, designed for spatialization of sound signals in real time. The virtual space of *Grit* is diffused through 8 speakers that have been arranged circularly, 45° apart from each other to complete the 360° domain.

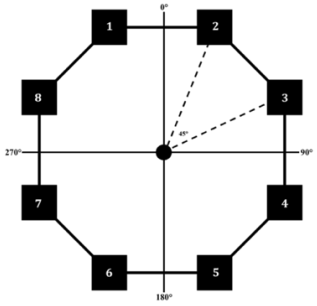


Figure 1.1: Diagram of Octophonic Setup

[22] Wen-Chung, Chou. 1966. "Varèse: The Liberation of Sound", *Perspectives of New Music*. Vol. 5, o. 1, pp. 11-19
[23] Wishart, Trevor. 1996. *On Sonic Art.* Contemporary Music Studies. Vol. 12. OPA (Overseas Publishers Association). Amsterdam, Netherlands: The Netherlands by Harwood Academic Publishers GmbH, p. 201

From the opening figure of the work, *Grit* seeks to make a strong statement about its conception of spatialization by applying both types of motion on the first audio file heard in the piece. The particular audio file lasts for 8". Upon analyzing the contour and gestural profile the sound conveys, I initially divided its totality into two parts, with the point of division to be at 4250ms. For the first part, the motion is defined *irregular*, while in the last 3750ms of the sound the movement is *direct*. During the course of the first part, the sound is initially projected at the point of 0°, stays for 2250ms, then jumps to 90° for 1000ms, and all the way to 270° for another 1000ms. From that location, the *direct* motion is initiated with the sound moving clockwise covering the space back towards to the point 0° for the next 1950ms where it rests. With the activation of cue #2, the second audio file is heard from 180° moving away 3 meters from the perimeter for the duration of 7".

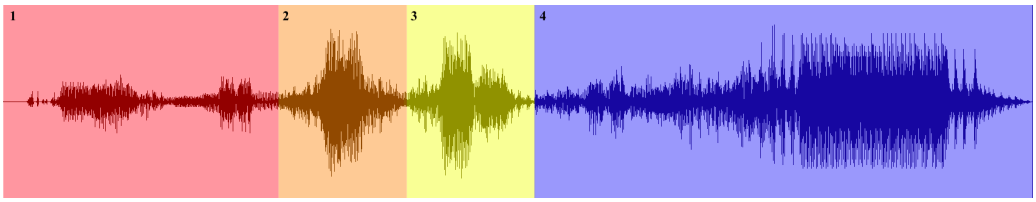


Figure 1.2: Division of Activity in Cue #1

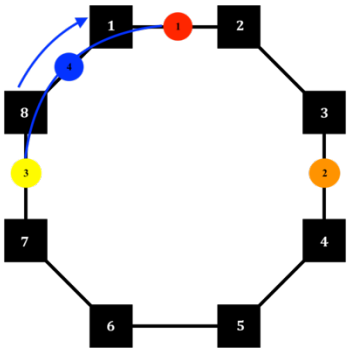


Figure 1.3: Spatialization Trajectories in Cue #1

The example can be heard here: www.theocharis-papatrechas.com/dissertation-audio-1

Through the course of the work, there are also instances where two or more audio files are being played concurrently, each conveying a different type of motion. An example of this phenomenon exists in cue #11, where, as shown in the score, two audio files are triggered simultaneously, each lasting for 9". The second of those –presented in the lower staff of the electronic part of the score– presents continuity, stability, and linearity in its content, while the upper layer lays out a more intense activity with several fluctuations in dynamic and articulation.

Similar to the approach I followed for the previous example, I proceeded to split the duration of the file into parts, taking close attention to the trajectory of the contour. As Figure 1.4 shows, four parts were defined. To spatialize the particular sound, I applied overall the model of *irregular* motion, while it could be observed each of the individual parts carries out a *direct* trajectory till it jumps to the point for the next line of movement to begin. Figure 1.5 offers an insight into each of the trajectories implemented in each part. Starting from the point 180°, the activity of the first part is heard moving clockwise to point 45° over 3250ms. Then, the line jumps to point 225° following, in contrast, counterclockwise *direct* motion all the way to the center (0°) in the duration of 3". Continuing further, the third part begins its journey at point 135° moving again counterclockwise to point 270° over the period of 2500ms. The last part's motion is static, maintaining its position at 270° till the end of the file.

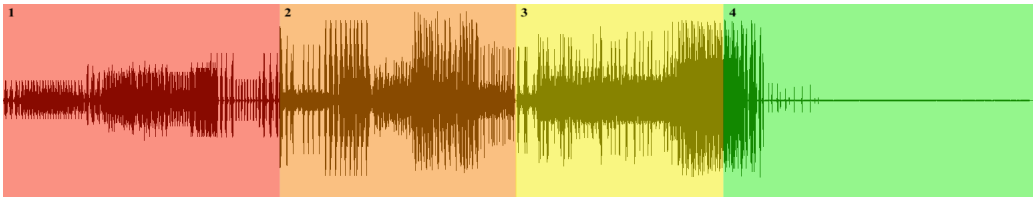


Figure 1.4: Division of Activity in Cue #11 (Audio File 1)

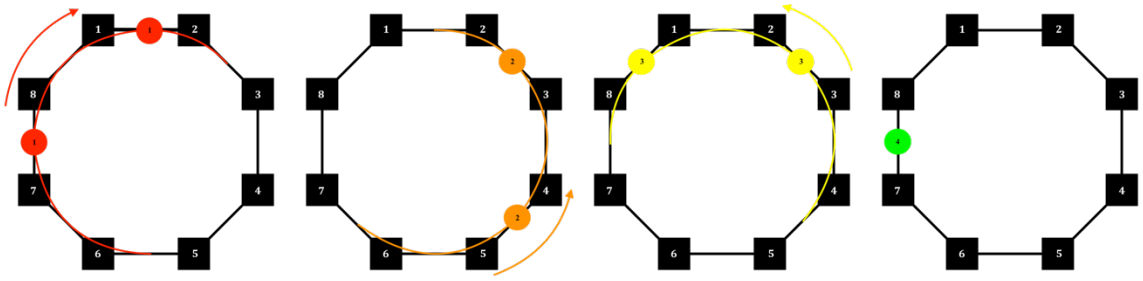


Figure 1.5: Spatialization Trajectories in Cue #11 (Audio File 1)

The example can be heard here: www.theocharis-papatrechas.com/dissertation-audio-2

As an antithesis, the second file is projected in space incorporating solely *direct* motion. It starts from point 0° and, moving to the opposite way of the initial state of the first file, completes an entire circle till it finally lands at point 90°. The intention of the simultaneous application of the two types of motion the work occupies itself with is once again to form scenarios where the two conceptual ideas of continuity and fragmentation are equally valid and dominant. In addition, the phenomenon occurring with the implementation of dissimilar concurrent directivities existing in different points within the formulated virtual space, as becomes apparent with the initiation of the electronic activity in cue #11, aims to highlight the presence and, thus, significance of the dimension of space. It opens up the spatial perception of the listeners providing them with the possibility to fully experience and appreciate the differentiation of the material presented at the same time without compressing any qualities of it, as it would have been the case if the two layers were merged and projected within the stereo field.

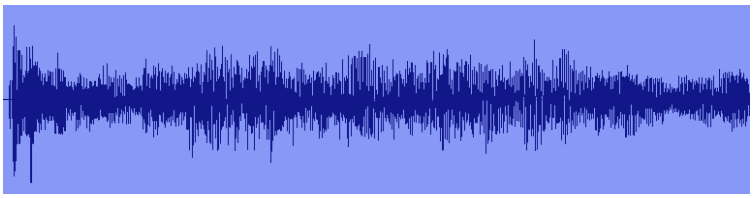


Figure 1.6: Division of Activity in Cue #11 (Audio File 2)

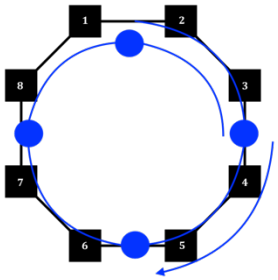


Figure 1.7: Spatialization Trajectories in Cue #11 (Audio File 2)

The example can be heard here: www.theocharis-papatrechas.com/dissertation-audio-2

Another technique used that seeks to strengthen the argument of the use of space as an integral compositional dimension, relies on the association of sonic material with particular spatial presence and motion. *Grit* presents numerous instances where every occurrence of a specific sound, or combination of sounds, suggests the same approach to spatial localization and movement. An indicative example of this category of material involves a set of individual strikes articulated on woodblocks that have been lightly electronically modified. The set is found in cues #10, #21, #23, #24, #33, #44, and #45. The approach to orchestrate some evocative gestures combining many of these minute attacks requires a process of micro-management. In each of these instances, the individual attacks are placed extremely close together while each is asked to appear from a distinct spot in space.

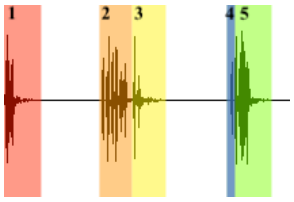


Figure 1.8: Division of Activity in Cue #21

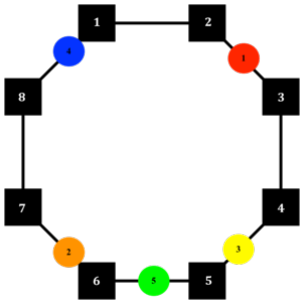


Figure 1.9: Irregular Motion in Cue #21

The example can be heard here: www.theocharis-papatrechas.com/dissertation-audio-3

Figures 1.8 and 1.9 display the approach towards the spatial distribution of the separate sonic activity that comprises the second portion of the phrase articulated by the electronic part in cue #21. This fragment lasts for about 1500ms and consists of 5 distinctive woodblock attacks. The circumstance of the use of an extensive portion of the virtual space within such a tiny frame of time primarily offers special acknowledgement to the projected material, giving gravity to it, elevating its value and meaning in the composition. Additionally, the phenomenon purposes to raise the listeners' awareness of the existence and potentiality of the surrounding space.

In conclusion, *Grit* incorporates a plethora of electronic and acoustic compositional ideas, ones in which I intuitively curated through the process of exploration and investigation. The outcome of the work provides an insight into not only dualities of process, but dualism of sound sculpture and curation, highlight the dichotomy of fragmentation and continuity.

Chapter Two:

Pythmenas (2019) – a 3D audio installation for 28 channels

2.1 Objectives:

Drawing its inspiration and data from natural habitats and urban environments, *Pythmenas* (Greek word for 'bottom of the ocean') is a collaborative 3D audio installation work that took place at the Spatialization Lab of the Qualcomm Institute at the University of California, San Diego in May 2019. Originating from a postgraduate seminar entitled "Hearing Seascapes" led by Professor of Composition Lei Liang, I created this work with the generous collaboration of my esteemed doctoral colleagues from the performance Department at UCSD – Alexander Ishov, flutes; Dimitrios Paganos Koukakis, piano; Ilana Waniuk, violin; Rebecca Lloyd-Jones, percussion.

The seminar "Hearing Seascapes" was oriented in exploration and creation, inviting the student body to combine oceanic data, and to develop new and innovative ways to couple data with music. The outcome of this was not foretold, but rather a journey in which each individual could maneuver at their discretion. During the course of the seminar, the class had the privilege of inviting oceanographer Joshua Jones to present his research over the course of several sessions. I was and am continually inspired by Jones' work. The way in which he offers a glimpse into the fascinating world of the underwater universe and provides insight into his long-term research regarding underwater audio recording through the utilization of hydrophones placed at the bottom of the Arctic Ocean (but of particular grandeur is his intimate knowledge and virtuosic ability to vocalize any species of whale call upon request!).

Influenced by this particular process of recording and the merging of three worlds (i.e. ocean species, humans, technology), *Pythmenas*'s premise was to combine these three distinct components to create a musical experience. The ocean data is the hero of this work. It acts as the primary agent of inspiring the entirety of the artistic work. The sonic profiles taken from recordings of several of the living organisms (different species of whales etc.) are being interpreted by the instrumentalists, who carry out carry out soundings inspired by the ocean and transfer that into an above ground improvisatory universe. Technology, the last constituent, intervenes capturing and processing the activity of the performers as well as manipulating the original recorded media. The final outcome is the audio registration and fusion of the totality of layers projected and spatialized through an infrastructure of 28 spherically configured loudspeakers arranged three-dimensionally in 4 levels – 4 on the ground, 12 at ear-level, 8 6-feet above, and 4 on the ceiling.

This section of the paper focuses on the two main parts of my involvement in the project. I was responsible for, firstly, the *Sound Sculpting* process of the original acoustic data and, secondly, the construction of a Max/MSP patch that would gather all the materials (the raw data and the recorded signals from the instrumental forces), process them, and diffuse them into the performance space for an installation type performance setting.

2.2 *Sound Sculping*:

Initially, the team of *Pythmenas* was provided with the raw acoustic data as recorded in the Arctic. The material used in the work combines mainly the sound profiles of beluga and bowhead whales. Before going further into the process of incorporating the audio files into the tape component of the work, the step of *Sound Manipulation* of my *Sound Sculpting* procedure

needed to interfere for the proper designing, shaping, and, thus, presentation of the sounds in the context of the audio installation work and I will outline these processes below.

• Down-sampling:

The original audio files are recorded in sampling rate 200kHz. Taking into account the infrastructure and properties of the sound system of the space in which the project was to be performed, my first step in the process was to down-sample all the audio files to 44.1kHz.

• Reboot Noise Reduction:

The recording system to which the hydrophones are connected underwater is set to reboot every 75 seconds. The reboot process lasts for approximately 13 seconds. I simply removed the segment that includes the profile of the particular type of noise (as seem below in Figure 2.1).

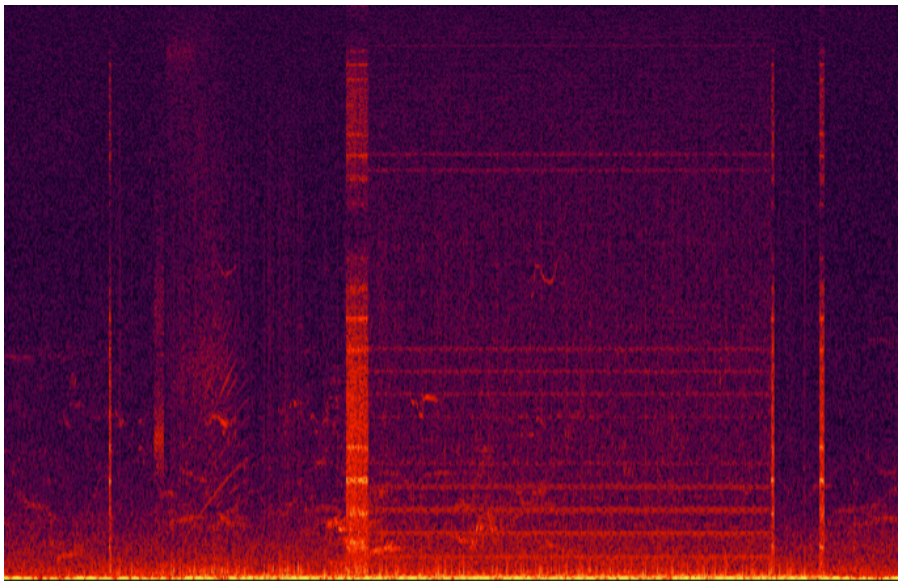


Figure 2.1: Reboot Noise Profile Spectrogram

• Instrument Noise Reduction:

While operating, the instrument itself produces a noise profile that consists of a set of frequencies. The 6 identified frequencies are: ~1546Hz, ~3090Hz, ~4635Hz, ~6083Hz, ~7629, ~9175. In this case, I proceeded with the attenuation of the particular frequencies via the application of band-stop filtering (as seen below in Figures 2.2 and 2.3).

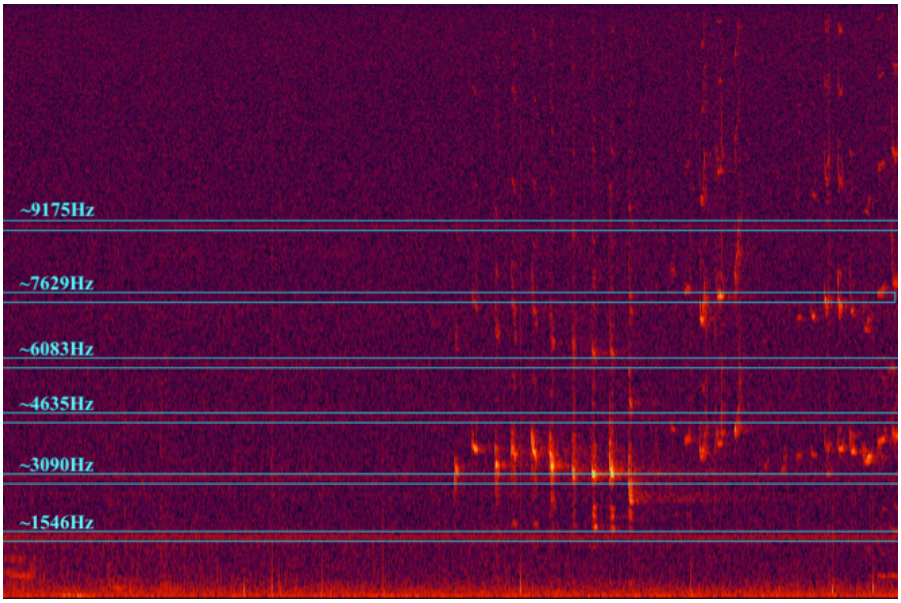


Figure 2.2: Instrument Noise Frequency Identification

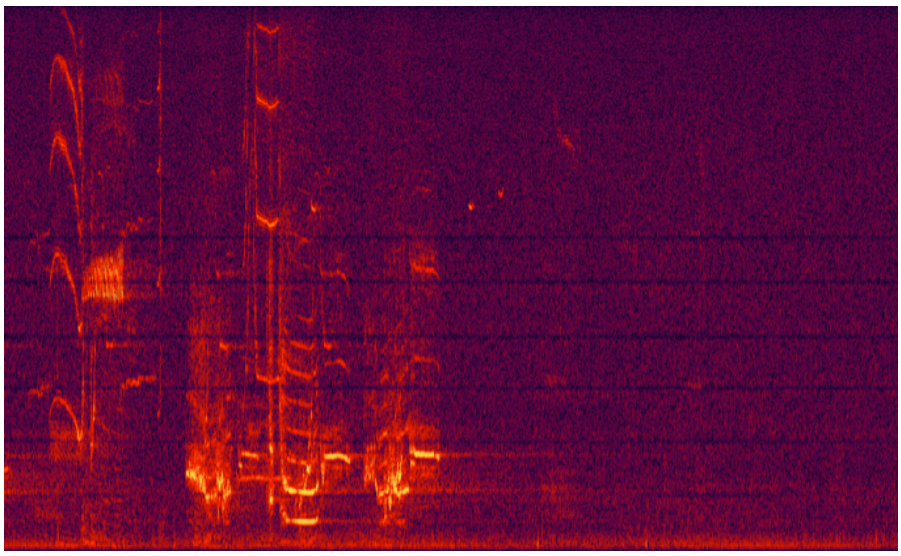


Figure 2.3: Instrument Noise Reduction

• Click Removal:

Due to system's occasional CPU overload or buffer overflow, clicks are caused and are subsequently removed (as seen below in Figures 2.4 and 2.5).

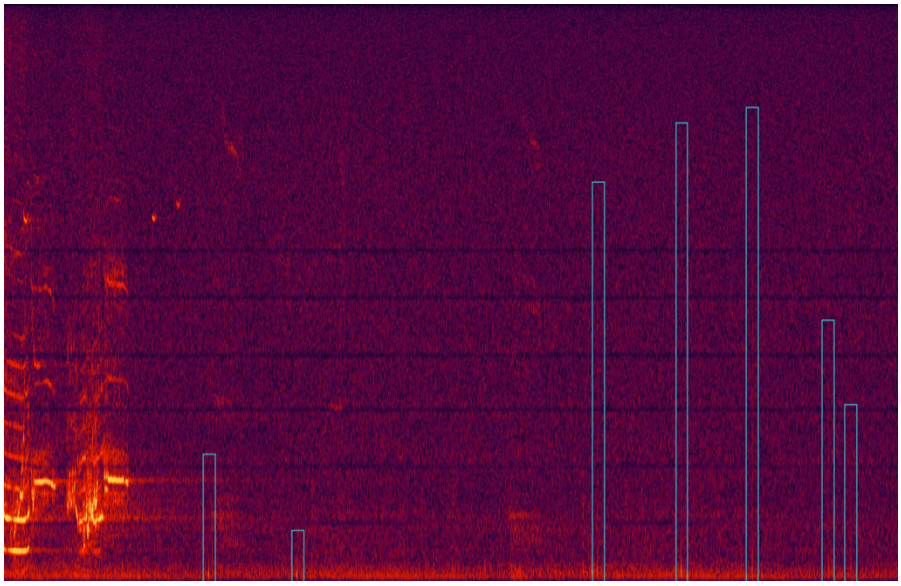


Figure 2.4: Click Identification

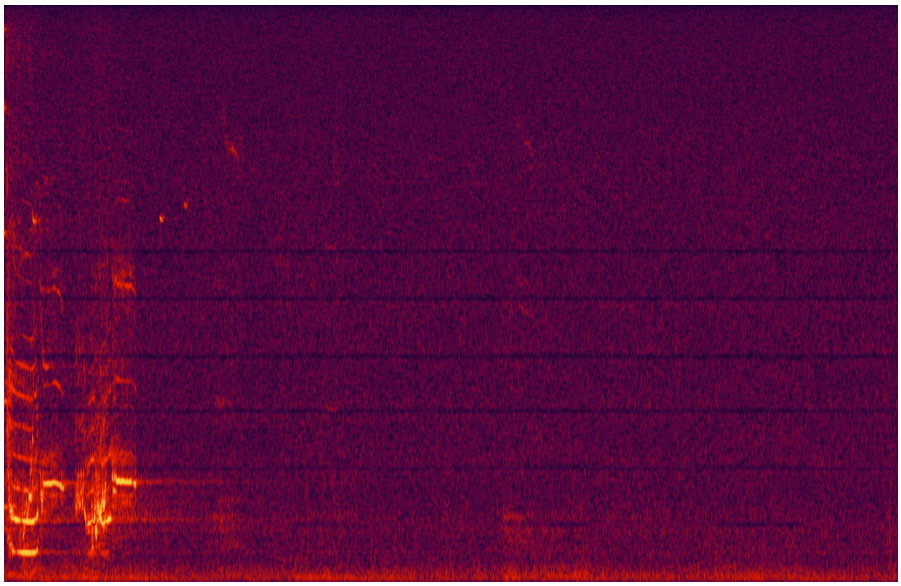


Figure 2.5: Click Removal

• Ambient Noise Reduction:

The last step in the *Manipulation* process involves the reduction of the levels of ambient noise and background sound pressure (as seen below in Figure 2.6).

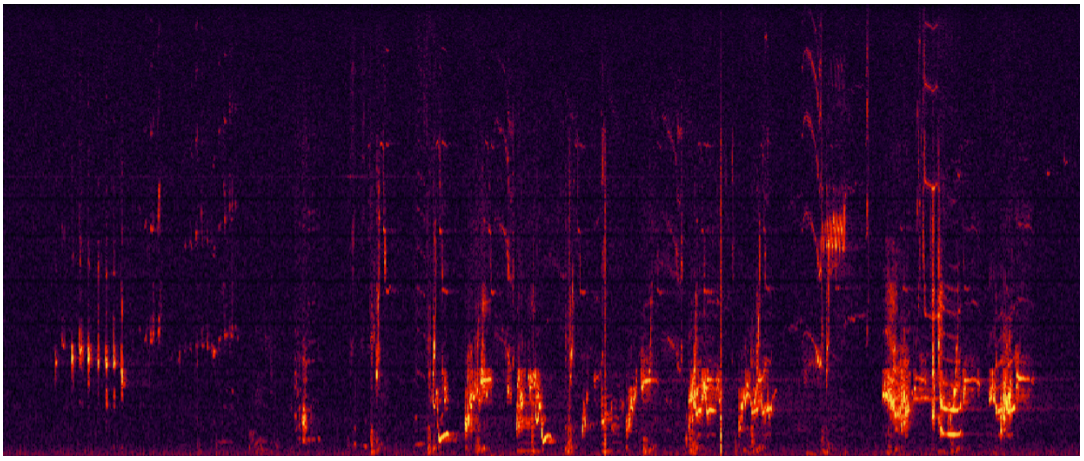


Figure 2.6: Ambient Noise Reduction

An example with audio samples for every step of the process can be found here: www.theocharis-papatrechas.com/dissertation-audio-4

Following the manipulation process of the original data, the four performers were provided each with a list of sounds to experiment with and interpret. As an example, the pianist (Dimitrios) interpreted the sonic profile of the fin whale, which produces short segments of sound in the range between 80 and 100Hz. Figure 2.7 below presents the spectrogram of about 15 seconds of fin whale activity ranging between 0 and 250Hz, while a spectrogram of the same range lays out the interpreted version of the fin whale's sonic profile by Dimitrios in Figure 2.8. Dimitrios's approach to the sound utilized the technique of striking the strings of the lowest register of the piano with the palm of hand with no use of any pedals for the avoidance of any resonance.

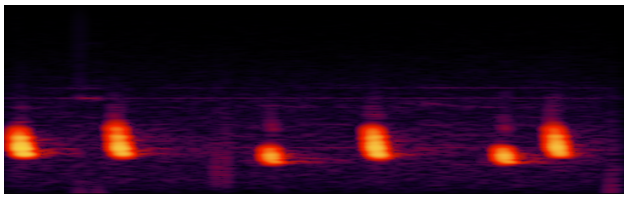


Figure 2.7: Sonic Profile of Fin Whale (Spectrogram 0-250Hz)

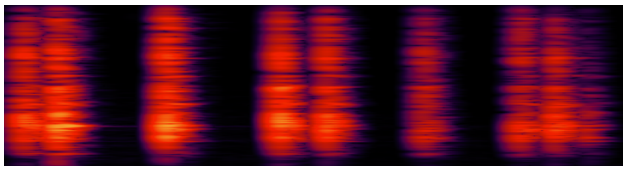


Figure 2.8: Sonic Profile of Piano's Version of Fin Whale (Spectrogram 0-250Hz)

Another example involves the sonic profile of a bearded seal, which generally elaborates a line of sound of about 16 to 20 seconds starting with a shorter ascending motion from ~1300Hz up to its peak at ~2000Hz, where then drops to ~900Hz continuing to gradually and slowly descend to ~300Hz over a period of ~10 seconds. The sound was interpreted by the violinist of the group, Ilana, who represented accurately the linear dimension of the sound in both time and frequency domains, embellishing with various techniques in the violin to provide to the outcome the medium's individualistic quality (as seen below in Figures 2.9 and 2.10).

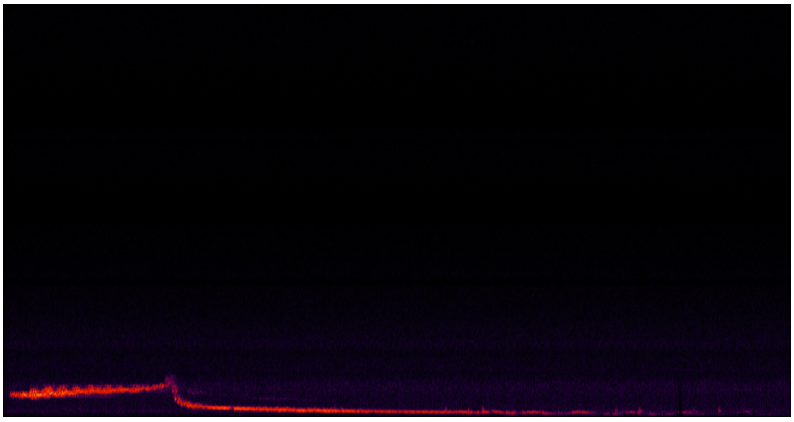


Figure 2.9: Sonic Profile of Bearded Seal

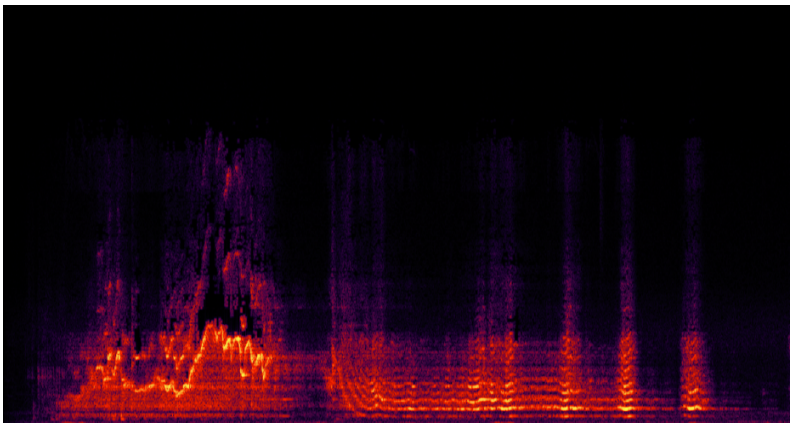


Figure 2.10: Sonic Profile of Violin's Version of Bearded Seal

The audio files of Figures 10-13 can be heard here:
www.theocharis-papatrechas.com/dissertation-audio-5

Following the performers' personal work period with the sounds from the assigned lists, three recording sessions took place, in which all four performers as an ensemble gathered and produced several takes of improvisatory action reacting to each other, utilizing the material which they had individually drawn inspiration from.

Throughout the recording sessions, and during the group collaboration process, the team collectively decided to elaborate on what material would or could be considering of principle importance to the creation of the work. Through this process the group concluded that intensity of sounds and gestures was of vital importance. Through this, we developed three distinct types of activity, with each parameter of intensity being approached from a different angle of execution by the performers. A series of 'takes' took place by the group, both as the complete ensemble of four and in smaller subsets of 2.

The three types of intensity mentioned above, were referred to as:

1. *Active-Inactive*: where one of the instruments leads presenting the main material that needs to be rhythmically and timbrally elaborate and intense, while the rest of the group unveils

an accompanying sonic scape.

2. *Active*: where all the instruments contribute with rhythmically and timbrally to elaborate and intense material.

3. *Inactive*: where the entire group decides on a distinct timbral quality that is being sustained throughout the take without any member sonically dominating.

During the sessions, the performers' signals were individually recorded. The next stage into the construction process involved the export of the stems as separate libraries of sounds, which were subsequently edited and imported into a DAW (Digital Audio Workstation) to be laid out in order to formalize the structure of the work.

2.3 Structure:

Collecting both the original designed data and the takes from the recording sessions, I was responsible to put together the entire project in a linear manner to formulate a musical dramaturgy. My approach was firmly associated within the original idea discussed with the group, that of varying intensities of sonic and gestural material. Upon starting to experiment with the material and step by step placing fragments of the recorded material one after another, I began gradually to formalize a contour utilizing the three types of intensity listed above. The outcome of this process takes the listener smoothly at times and unexpectedly at other times, shifting from one sonic situation to another.

The work is divided into 5 main sections, which I will outline below:

A. Active-Inactive [0'00" – 4'15"]

The section begins with the percussion being the protagonist, who is later joined by the piano, and then by the flute, who takes the lead at about 1'45". At 3'15" and until this section is

completed, the piano is the main character. Overall the activity of this section is sparse and slow, providing time and space for the material of every subsection to unfold properly and be experienced thoroughly by the listener.

B. Active [4’15” – 6’00”]

After laying out their individual sonic elements, the four characters join their forces in this section, formulating an intense dialogue until being abruptly interrupted by the contrasting following section.

C. Inactive [6’00” – 9’45”]

The material that is laid out in this section consists of a single pitch as a point of reference, which all the members articulate, sustain, meander around, and eventually, slowly, and collectively raise. The musical activity gradually progresses and is interrupted again by the second section of the piece, where intense activity prevails.

D. Active [9’45” – 13’45”]

A higher level of intensity is presented in this “Active” section comparatively to the second section of the work. About three minutes in, the energy, having reached its peak point, starts to dissipate and is gradually released till the point where the piccolo is heard whistling at 13’45”.

E. Active-Inactive [13’45” – 17’00”]

In a similar manner to the initial part of the piece, this last section develops a series of shorter subsections involving mainly the flute and the percussion interchanging roles. At 13’45”, the piccolo elaborates a line of high-pitched fast figurations, while the percussion begins to leisurely appear to finally dominate with some fricative activity on the tam-tam. The two proceed

with an ongoing dialogue until the last 30 seconds of the piece, where the percussion slowly fades leaving the ground for the flute's final breathy sounds.

Completing the formalization of the piece, by setting the order of the individual parts, I was then tasked with building the performance patch. The patch's role is highly vital in this instance as it is now the performer, whose role is to fuse, process, and project the totality of the layers to the 28-channeled space.

2.4 The Patch:

In its totality, the patch comprises of 3 main components that I have detailed below:

1. Audio file players and *mungers*

Four audio file players have been incorporated into the patch. Each of the four players is responsible for the pre-recorded material associated with each of the four instruments. The selected audio files from the Arctic were distributed evenly along the four players. More specifically, the order, with which the instruments were given to the players 1-4, is: piano, flute, percussion, and violin. Similarly, four *munger* objects have been included for the real-time processing of each of the four libraries, following the same order. Figure 2.11 below presents a screenshot of the foreground layer of the performance patch.

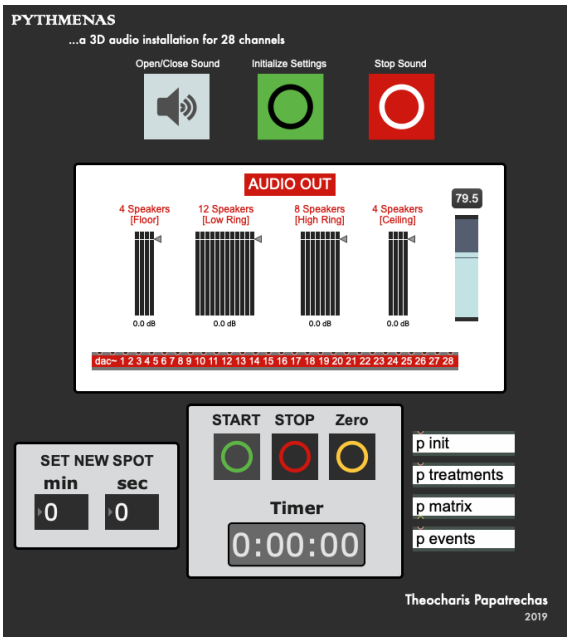


Figure 2.11: Screenshot of Main Patcher of *Pythmenas*

2. Cues and Timer

The overall activity of *Pythmenas* has been laid out in 21 separate cues. The cues have all been imported into a *select* object along with additional data referring to the exact timings at which the cues need to be activated. Under the umbrella of each cue, a number of audio files have been formed into line to be triggered. Along with the sounds, instructions are included regarding the trajectories the particular files should follow in space. In addition, a timer was built-in to count the global time throughout the course of the work. The timer is the agent responsible for spreading the various events in time as its output is exported directly into the cues' *select* object.

3. Spatialization

Similar to my work *Grit* which I discussed in Chapter 1, the component of spatialization is operated within the platform of *SPAT5.1* incorporated into the global patcher. The first procedure I followed when building the patch was to reconstruct the performance space in *SPAT*.

Through diagrams I was provided by the space manager of the Spatialization Lab at Calit2 with explicit information with regard to the number of speakers and distance measurements, I produced an imitation of the infrastructure of the speaker configuration setup of the space into the patch. As Figures 2.12 and 2.13 show, the space consists of 28 spherically configured loudspeakers arranged three-dimensionally in 4 levels – 4 on the ground, 12 at ear-level, 8 about 7-feet above, and 4 on the ceiling.

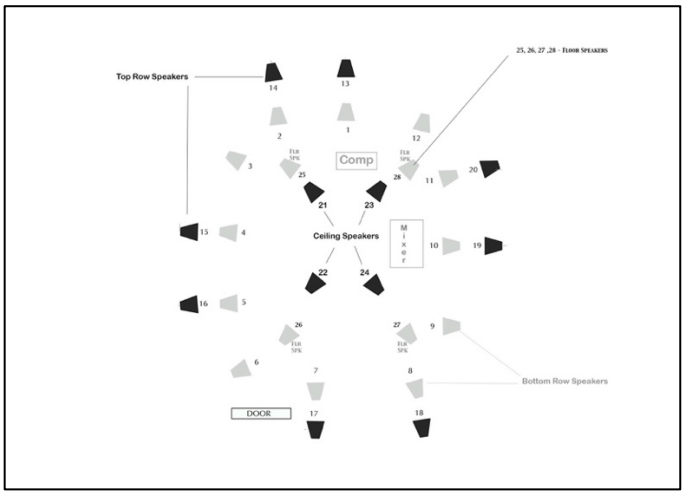


Figure 2.12: Spatialization Lab Speaker Position and Routing Diagram

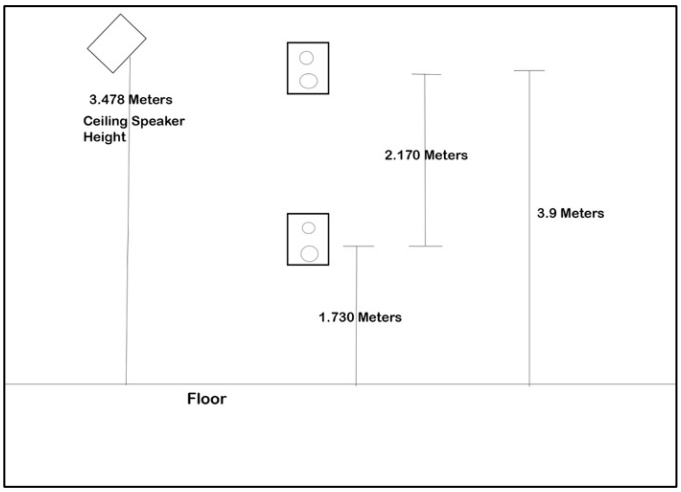


Figure 2.13: Spatialization Lab Speaker Height Measurements

The 3D spatialization trajectories were constructed and operated within the patch, utilizing the Ambisonics model in the 4th order and controlling three main attributes; azimuth, distance, and elevation. The parameter of azimuth refers to the angle the source appears in relation to the center in the *xy* axis, the distance specifies the distance of the source from the center with 1 meter being the default radius from the center to the perimeter of the ear-level ring, and the elevation indicates the angle the source appears in relation to the center in the *xyz* domain. By default, the center is considered the 'sweet spot' of the space, where the audio waves projected by all the speakers arrive to the listener at the same time – that is, the ideal position for the listener to experience the work.

Figure 2.14 below presents the spherical arrangement of the 28 speakers in two frames; the left frame indicates the location of the speakers and sources according to the *xy* axis (with *x* being left/right and *y* being front/back), while the right frame shows the *xz* axis (with *x* being left/right and *z* being top/bottom). In addition, the figure provides the mapping of the positions of the eight distinct sources as the patch is initialized. Furthermore, Table 2.1 offers the values for the attributes of azimuth, distance, and elevation for the initial positions of the eight sources.

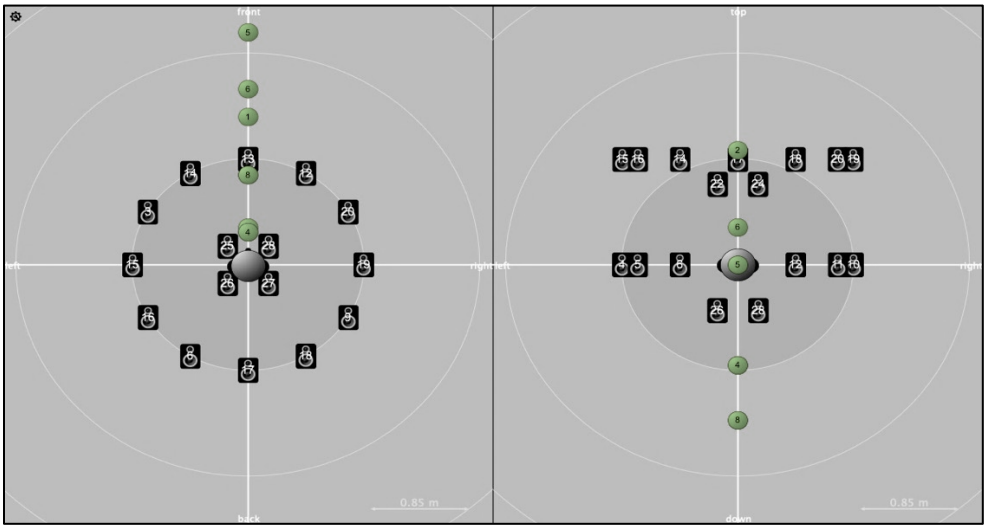


Figure 2.14: Speaker Arrangement and Source Initial Position in SPAT

Table 2.1: Azimuth, Distance, and Elevation Values at Initialization

	Azimuth (°)	**Distance (m)**	**Elevation (°)**
Source 1	0	1.4	0
Source 2	0	1.14	72
Source 3	0	1	-72
Source 4	0	1	-72
Source 5	0	2.2	0
Source 6	0	1.7	12
Source 7	0	1.7	-60
Source 8	0	1.7	-60

The opening motif of *Pythmenas* begins by the activation of an audio file that incorporates sonic activity of a bowhead whale having been transposed two octaves lower. The frequency band of the activity ranges between 50 to 80Hz. Considering the fact of the difficulty that arises for the perception of the localization of the particular sound due to the low frequency spectrum it conveys, I decided to place the sound below the bottom ring of speakers located on the floor of the room at a quite close distance from the center and have it complete one clockwise rotation from 0° to 360° over the period of 49 seconds. Having the sound moving on such slow pace, my intention with the spatialization was to fill the lower part of the space with those low frequencies in an effort not only to create for the listeners the sense of having been placed in great depth, but to also surround and embrace them with sound at the outset. Figure 2.15 lays out the spatialization trajectory of bowhead whale activity in Cue #1.

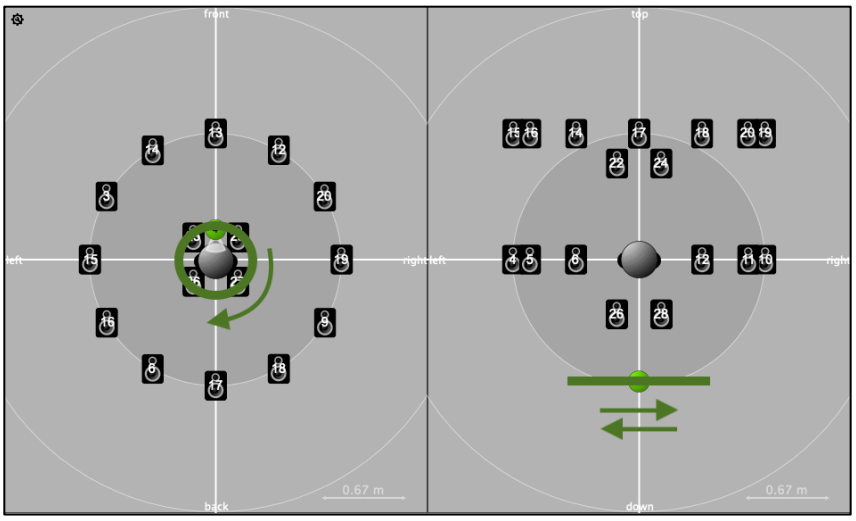


Figure 2.15: Spatialization Trajectory of Bowhead Whale Activity in Cue #1

Similar to the first cue, the movement of the activity in Cue #2 also covers the space below the bottom speaker ring. In this instance, the listeners are being presented with the first sounds coming from percussion instruments, and, more specifically, with some fricative activity produced by superballs on gong surfaces. In addition, the signal is being processed in real time by one of the *munger* objects, and the processed activity is sent to another source on *SPAT* for simultaneous movement. At the right side (top/bottom dimension) of Figure 2.16, we see the main percussion activity located about 0.5 meter below speakers 26-28, while the processed signal is located another 0.5 meter lower and in greater distance from the center, as can be observed in the left side (front/back dimension) of the figure. This concept, coupled with maintaining the movement in low speed, the lower part of the space is being extended further down to the *z* axis, amplifying even more the feeling of deepness.

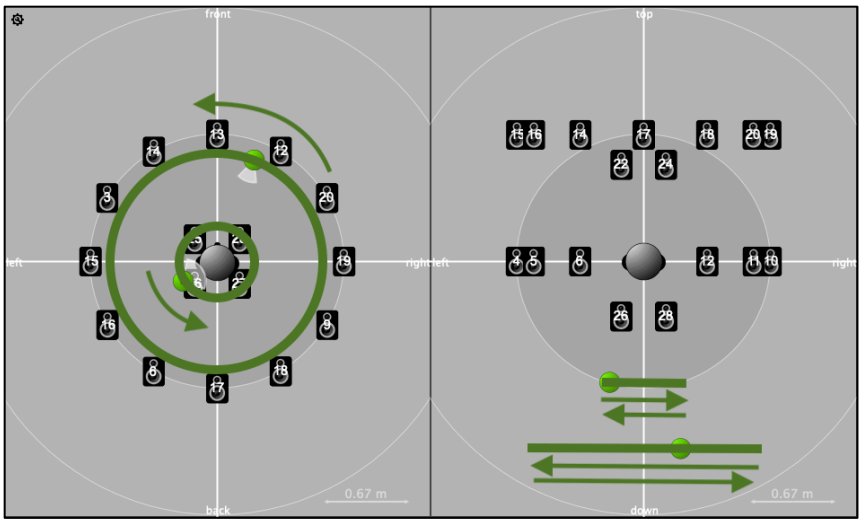


Figure 2.16: Spatialization Trajectory of Percussion Activity in Cue #2

Another fragment in the piece that presents a different and contradictory type of motion from the constant, slow, and quasi-meditative movement of the beginning, is heard in Cue #17. Elaborating a quite active and animated trajectory, the flute is the protagonist here articulating a series of air pizzicati. My approach to spatialization at this point was to translate the energetic and vigorous behavior of the flute to sound movement. Starting by analyzing the phrasal elaboration of the activity, I proceeded to divide it in a number of segments that presented different behavior with regard to the various musical parameters (i.e. rhythm, speed, intensity, stasis). At the end, I applied distinct instructions for spatialization to each of the segments. An excerpt from the flute activity heard in Cue #17 has been used as example in the link below, presenting its spatialization through a video of the graphical environment of *SPAT* accompanied with the associated audio in binaural format. The data for the attributes of azimuth and elevation along with the durations of each motion have been listed in Table 2.2.

Finally, apart from the decisions regarding the momentary spatialization movements of each one of the activated audio files, I had constructed a global plan that laid out a line with a series of points in the spherical space I was envisioning the trajectory of the musical activity to

follow. The main element that was taken into consideration to formalize this plan was that of elevation. Figure 2.17 below presents this structural schema, laying out the activity on the elevation-time axis.

Table 2.2: Division and spatialization instructions for Cue #17 (excerpt)

	Azimuth (°)	**Elevation (°)**	**Duration (ms)**
Segment 1	210 → 320	0 → -60	4000
Segment 2	320 → 10	-60	5000
Segment 3	10 → 100	-60 → 45	2500
Segment 4	100 → 310		2500
Segment 5	310		4000
Segment 6	310 → 20	45 → -60	3000
Segment 7	20 → 50		3500
Segment 8	50 → -180		6500

Videos of the spatialization trajectories with binaural audio for Cues #1, #2, and #17 can be watched here:

www.theocharis-papatrechas.com/dissertation-audio-6

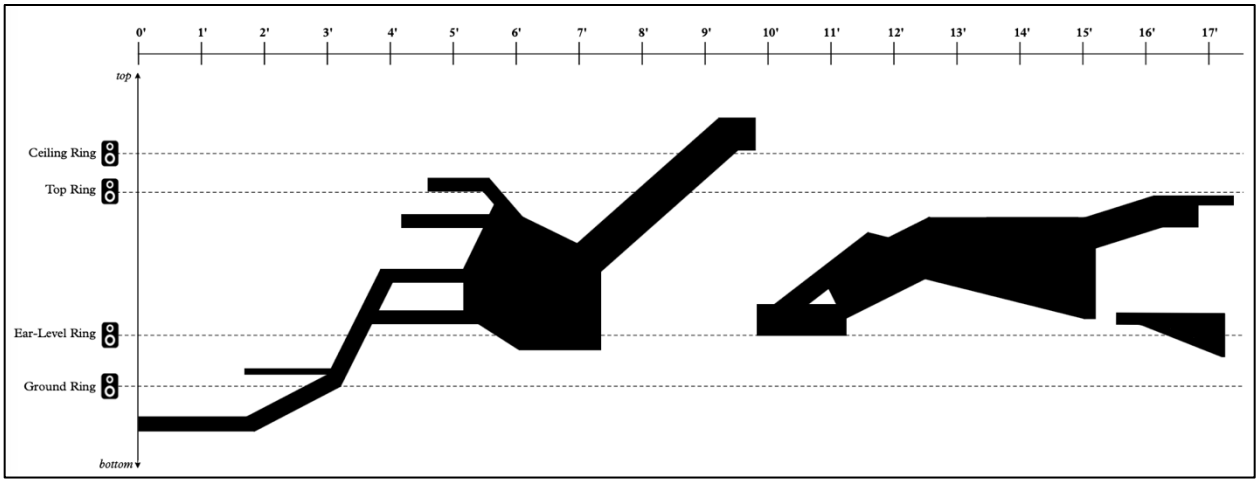


Figure 2.17: Structural Schema of *Pythmenas* on Elevation-Time Axis

In conclusion, *Pythmenas* is a work of grandeur that pays homage to the sounds and mammals that live beneath the ocean. Sounds and narratives which we are not privy too in our

daily lives, *Pythmenas* gives agency to the listener to engage with the work on their own terms, fusing mammalian lives and sonic imaginations. By illuminating the complex and beautiful sonorities of the deep, and by bringing them to the surface, I, with my colleagues have created a work which explores sonic intensities and creates imaginary narratives.

Chapter Three:

minute | from within (2019-20) – for amplified objects and electronics

3.1 Conception:

Originally premiered on the 6th of January 2020, *minute | from within* was a commission by my colleague at UCSD, percussionist Rebecca Lloyd-jones. Originally entitled simply *from within*, the initial work was composed for only amplified objects. The original formation of this work was purely acoustic and took on what I would call a more traditional approach to collaboration. In our initial collaboration process, Rebecca and I worked a few sessions together discussing and sounding instruments, exploring through possible modes of notation, and then I composed the score. Following this process, she worked on the material of the piece and it was premiered soon after. Post the performance, Rebecca and I discussed the possibility to re-work this composition with the potential of including electronics, and to also collaborate in a more in-depth capacity on the material to produce a different outcome of the piece. One year on from the original premiere, the new version of *minute | from within* for amplified objects and electronics was premiered at UCSD on December 18, 2020.

3.2 Collaboration and Composition Process:

My main attraction to the sonic world presented in this work was my preoccupation with objects as resonant chambers. Giving special emphasis to the sonic potentiality of a single touch, this work presents a combination of tactile and very soft gestures, which, without the amplification of the instruments, would not be audible to the audience/listener. By strengthening the objects' natural signals, I seek to overpower the minute sonic intricacies of the objects' inner

spaces, and, therefore, the listener is invited into a juxtaposed micro and macro sound world, a sonic terrain that almost simulates a world within a world.

Although the instrumentation and the concept for the piece remained the same from its inception, the form and material of the work changed dramatically over our collaborative process. In a way, it feels accurate to say that we composed this piece in reverse, with the score being notated in full post the recording process. Seeking to sonically explore objects made of different materials, the work is scored for box (wood), pipe (metal), flowerpot (clay), and bass drum with the bottom head removed (skin). Each instrument is being amplified through a microphone placed inside its body, and being executed with the performer's hands (i.e. fingertips, nails, knuckles), various types of brushes (i.e. dish, wire, nylon), a plastic comb, and a superball (Figure 3.1 below shows the performance setup along with the items needed for execution).

Figure 3.1: Setup for *minute | from within*

Overall, the collaboration and composition process occurred in four main stages:

i) recording of materials to be used for the electronic component

ii) recording of the work, the official recording session

iii) postproduction and formulation/creation of the electronics

iv) creation of the score

It is significant to note that all the stages of the process of *Sound Sculpting* mentioned in the two previous chapters were also utilized thoroughly while creating/composing *minute | from within*. More specifically, the first step of my process, that of *Sound Discovery*, at this stage, has already occurred while exploring and experimenting with the various sonic possibilities offered by the chosen instrumentation prior to the creation of the original score. The second step, that of *Sound Recording*, took place with the two recording sessions – one for the registration of materials to be included in the electronics and the other when the piece was recorded in its entirety. Lastly, the third and final step, that of *Sound Manipulation*, happened during the postproduction stage of the process when making the fixed media (all of these processes I will outline in detail below).

1. Recording of Materials: To initiate the entire process, we began recording the sounds of the objects to gather the sonic material that would become the electronic component to the work. This involved the performer improvising material and gestures over all of the instruments, with various modes of execution, i.e. hands/brushes etc. This process also involved some of the original notated material from the original score. Additionally, during this stage, we began to discuss possible versions of the form of the piece. We looked intensely at the notation already composed, and discussed what was necessary to remain, and what elements could be modified to bring about a more efficient execution of the piece. It is worth mentioning here that I realized

that some gestures were unnecessarily technical, and a more fluid approach to rhythm and time, would achieve the same sonic affect/outcome. With freeing myself of the idea of complex notation and gestures, Rebecca and I began to truly collaborate on the form and material of the work, both contributing equally to the outcome. Over a process of two-three weeks, we exchanged ideas and developed a vague scheme for the work, one which would be finalizing in the recording process.

2. Recording of the Work: The next step of our process involved the official recording session which lasted for two full days, December 17 and 18, 2020. In that session, audio and video were recorded simultaneously. Pre-deciding key anchor points for the piece, and with some decisions (but not all) made about the form, we went into the recording session open-mindedly about what we would produce. It is important to note that at this point in time we did not know what the piece would become. We had agreed on developing a fluid and improvisatory collaboration space but not what the pieces outcome would be.

Below, I have outlined the six pre-decided anchor points from the original score, and their correlating notational material labelled i-vi and presented in figures. Additional figures have been used to present the same activities as eventually transferred to and laid out in the new version of the score (Appendix #2).

i) The first 2 pages of the original score (shown in Figures 3.2 and 3.3) remained relatively unchanged. Figures 3.4 and 3.5 show the same material as laid out in the new version of the score.

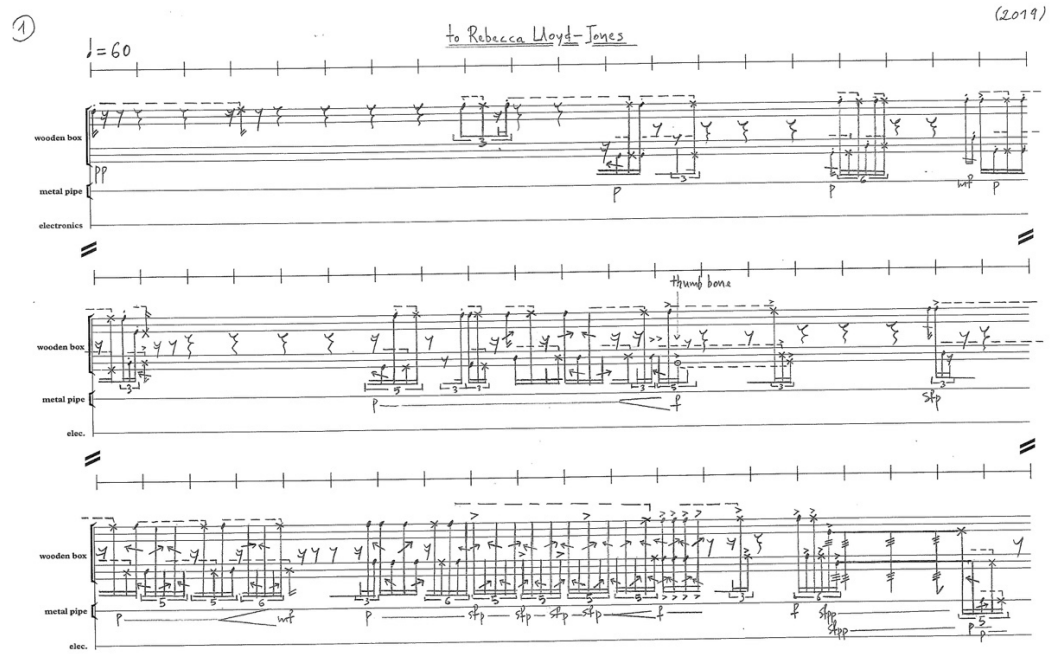


Figure 3.2: Page 1 (Original Score)

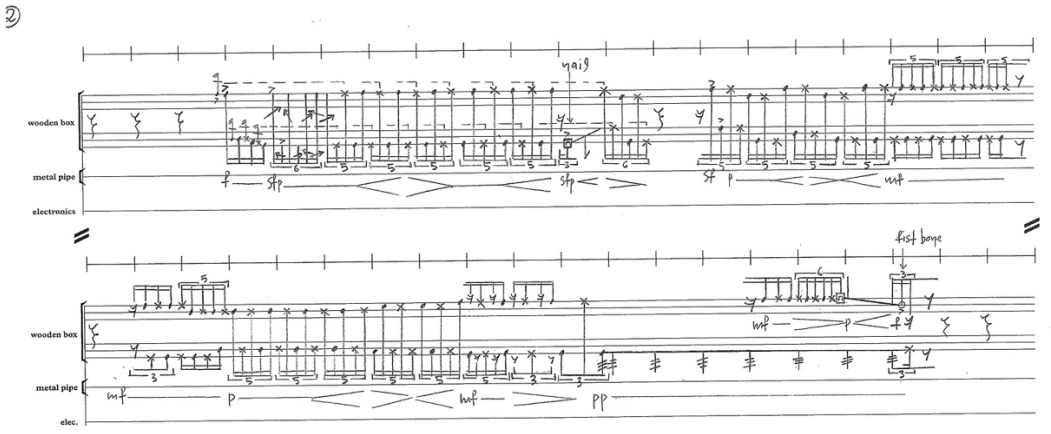


Figure 3.3: Page 2 (Original Score)

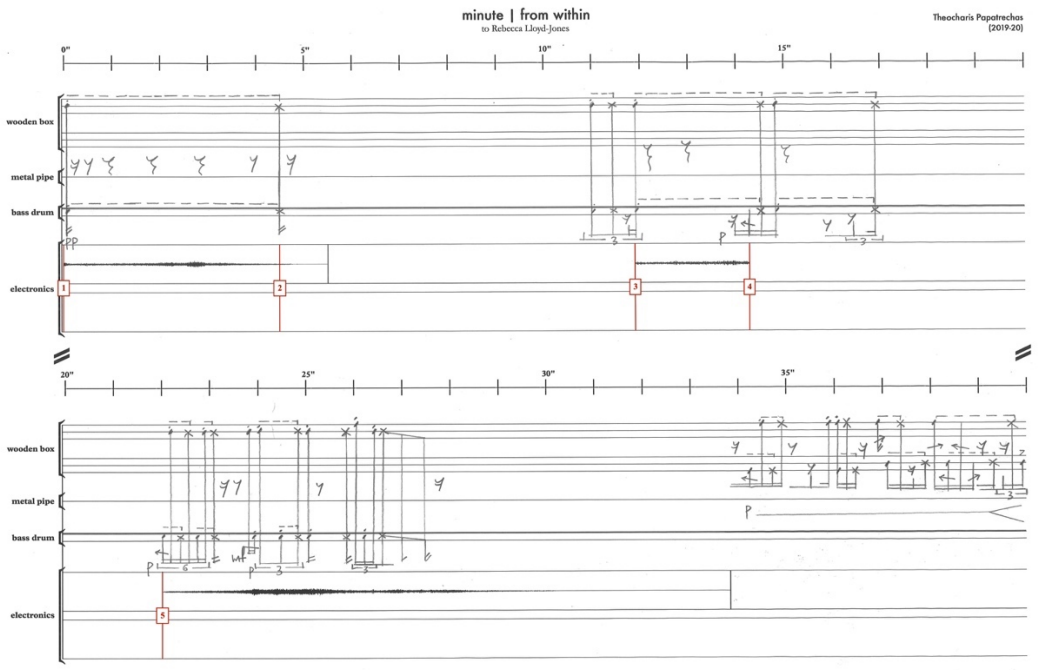


Figure 3.4: Page 1 (New Score – Appendix #2)

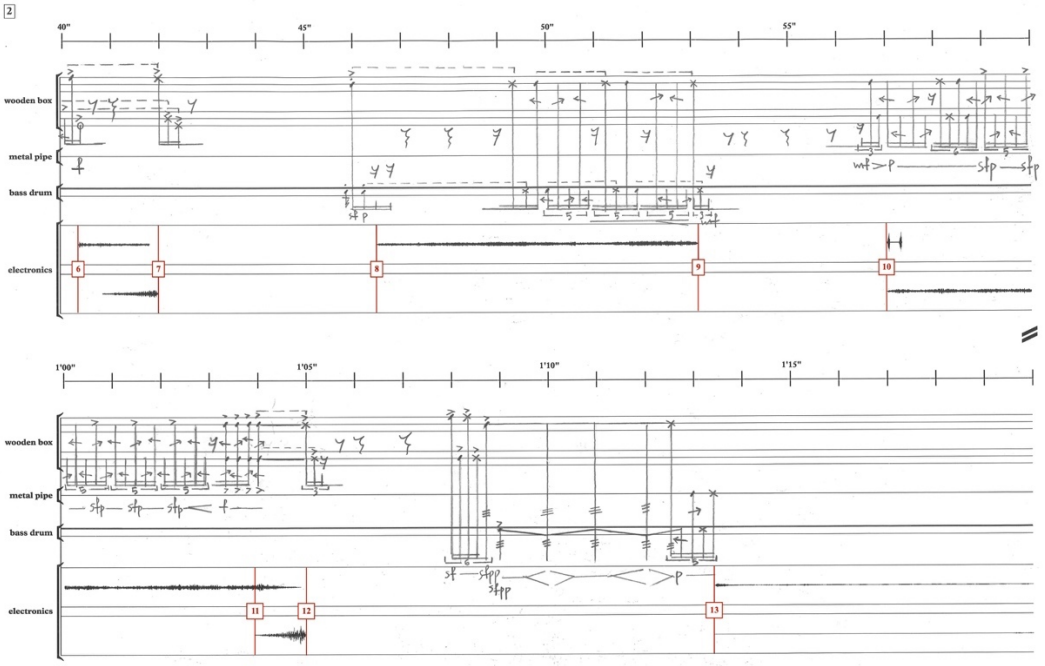


Figure 3.5: Page 2 (New Score – Appendix #2)

ii) The very first superball gesture performed on the metal pipe as seen on end of Page 2 of the original score as shown in Figure 3.6 below. Figure 3.7 presents the same material as laid out in the new version of the score.

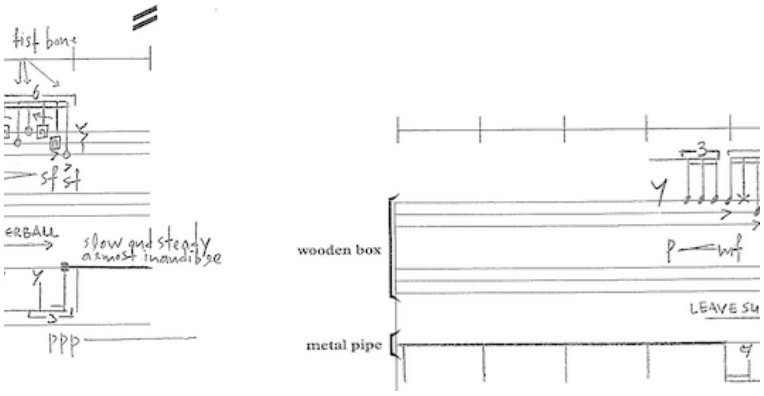


Figure 3.6: First Superball Gesture (Original Score)

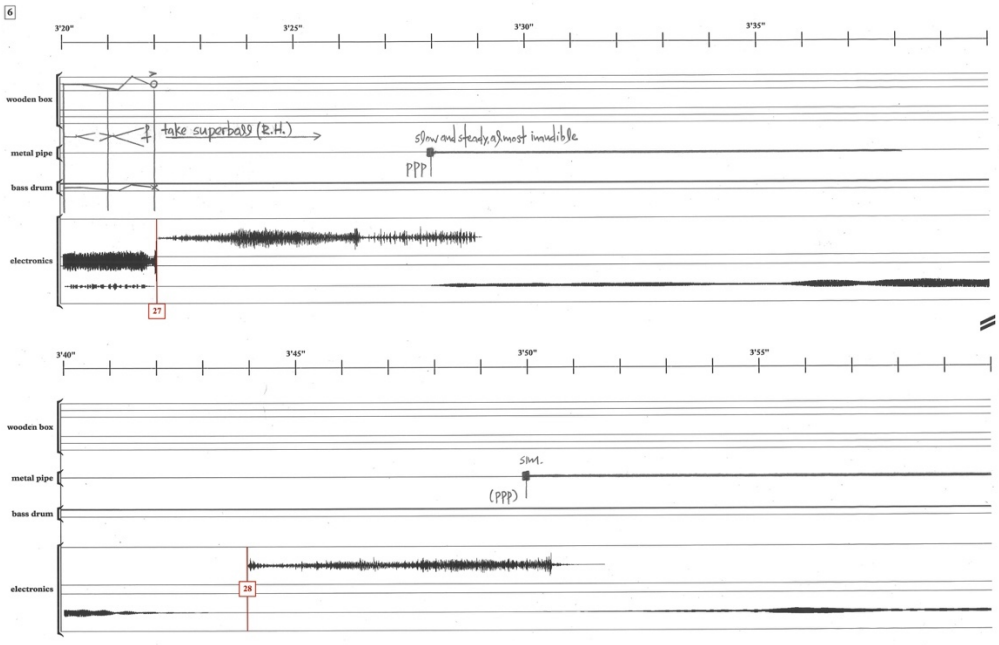


Figure 3.7: First Superball Gesture (New Score – Appendix #2)

iii) The dish brush gesture on the bass drum as seen on Page 4 / end of System 1 of the original score as shown in Figure 3.8 below. Figures 3.9 shows the same moment as laid out in the new version of the score.

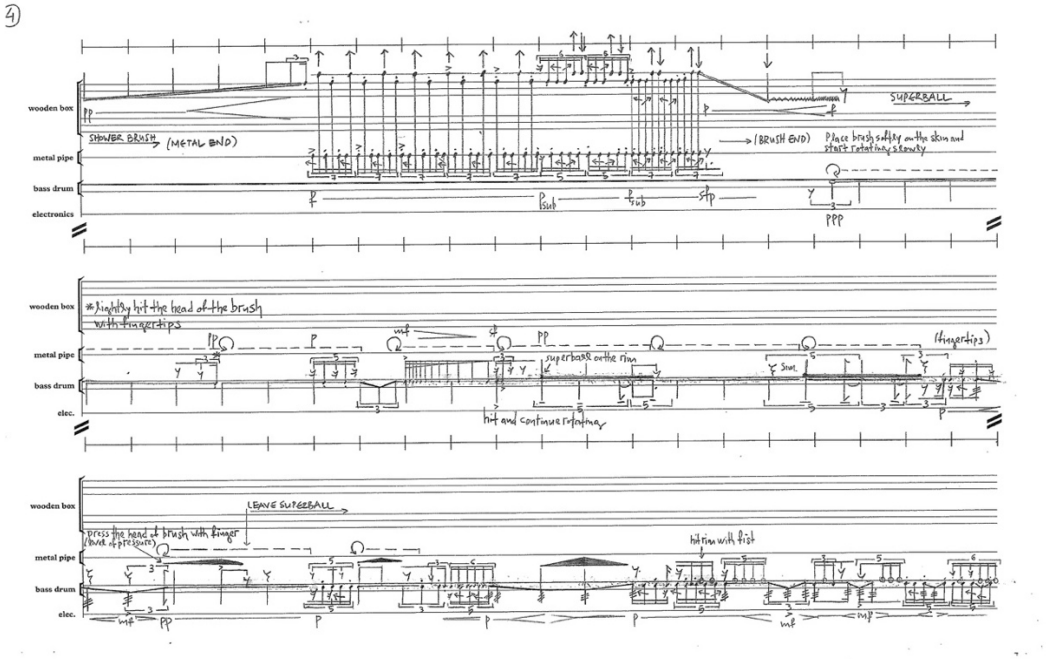


Figure 3.8: Dish Brush on Bass Drum (Original Score)

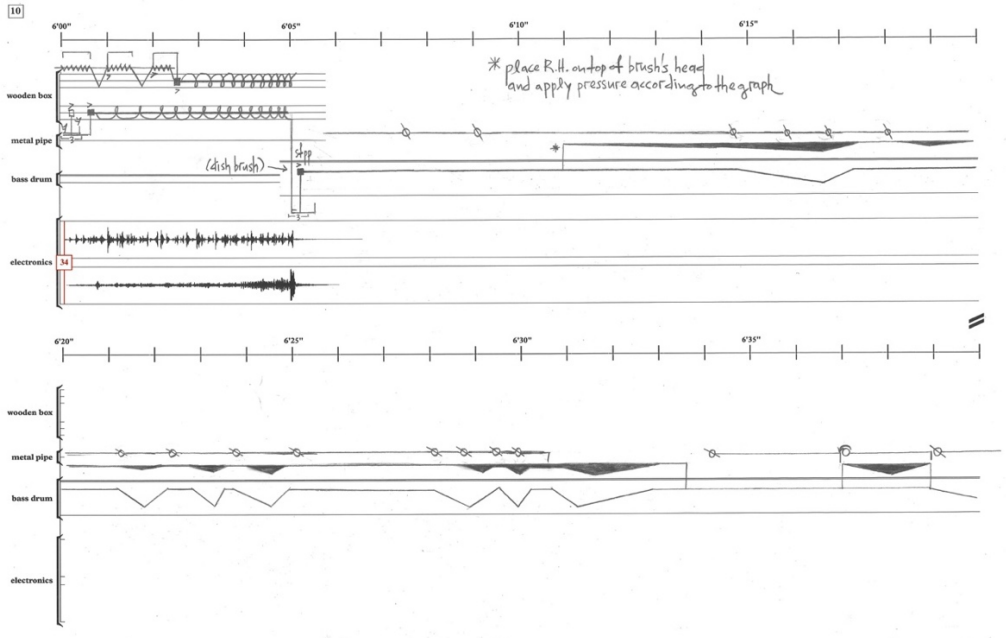


Figure 3.9: Dish Brush on Bass Drum (New Score – Appendix #2)

iv) Elements of pulse in the form of rhythmic patterns from the original score shown in Figures 3.10 and 3.12. Figures 3.11 and 3.13 show the same material as transferred to the new version of the score.

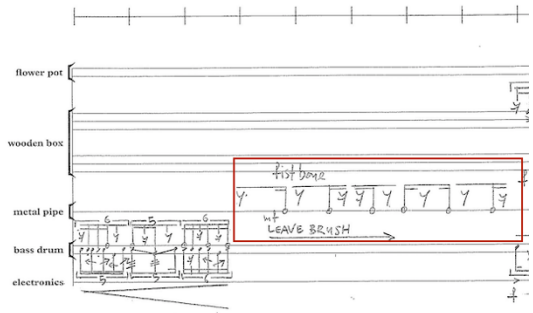


Figure 3.10: Metal Pipe Pattern (Original Score)

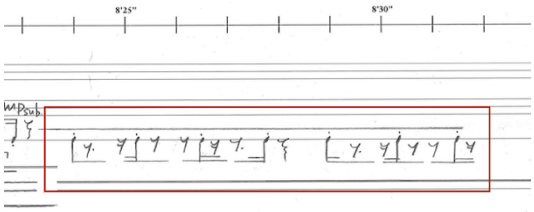


Figure 3.11: Metal Pipe Pattern (New Score)

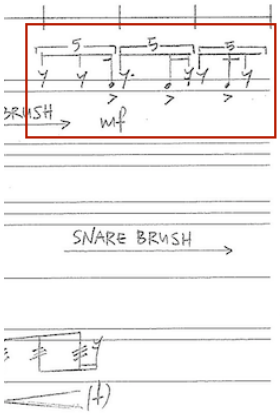


Figure 3.12: Flowerpot Pattern (Original Score)

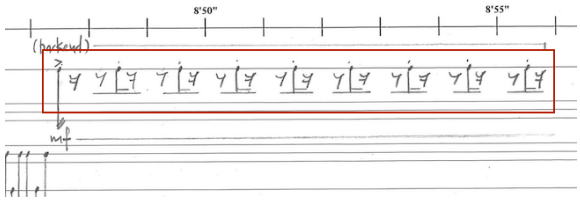


Figure 3.13: Flowerpot Pattern (New Score)

v) Elaborate and rhythmically active gestures spanning across all the instrumentation from the original score shown in Figure 3.14. Figure 3.15 present similar activity as transferred to the new version of the score.

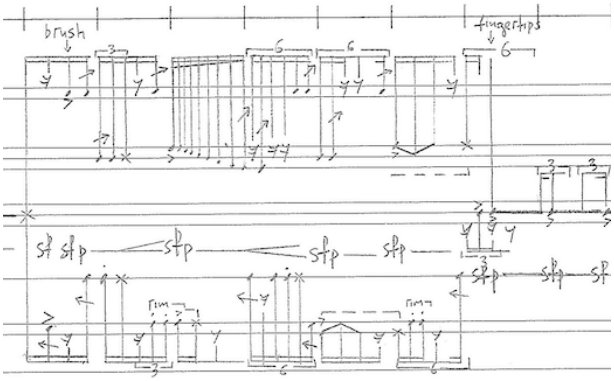


Figure 3.14: Example of Elaborate Gesture (Page 7 / Original Score)

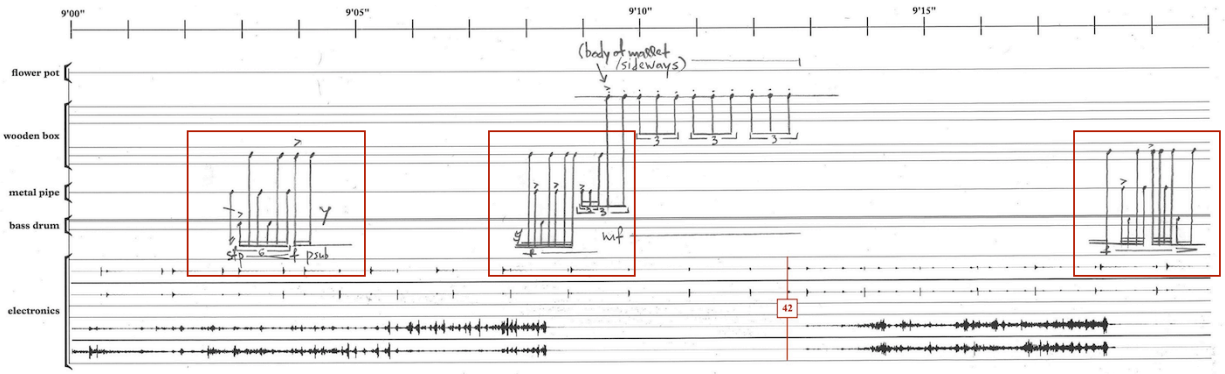


Figure 3.15: Example of Elaborate Gesture (Page 14 / New Score – Appendix #2)

vi) The wire brush on the wooden box as notated in the original score shown in Figure 3.16). Figure 3.17 presents the same activity as used in the new version of the score at the end of the piece, outplaying the electronics.

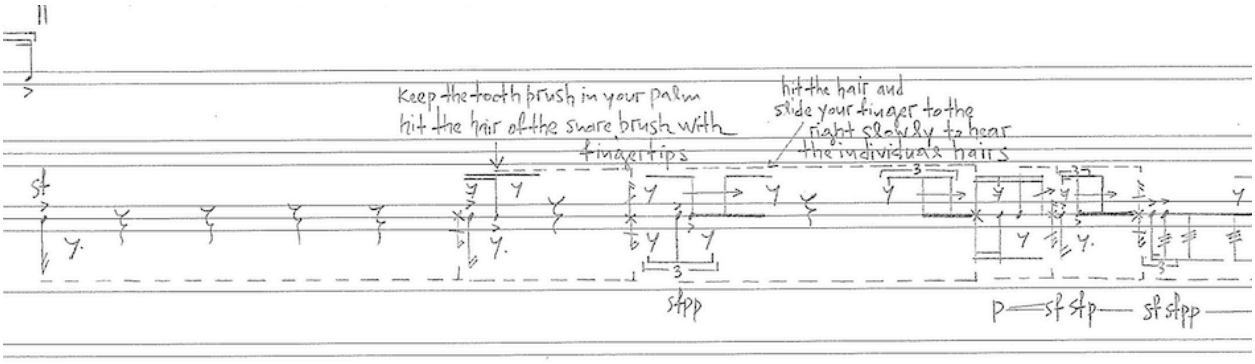


Figure 3.16: Wire Brush on Wooden Box (Page 6 / Original Score)

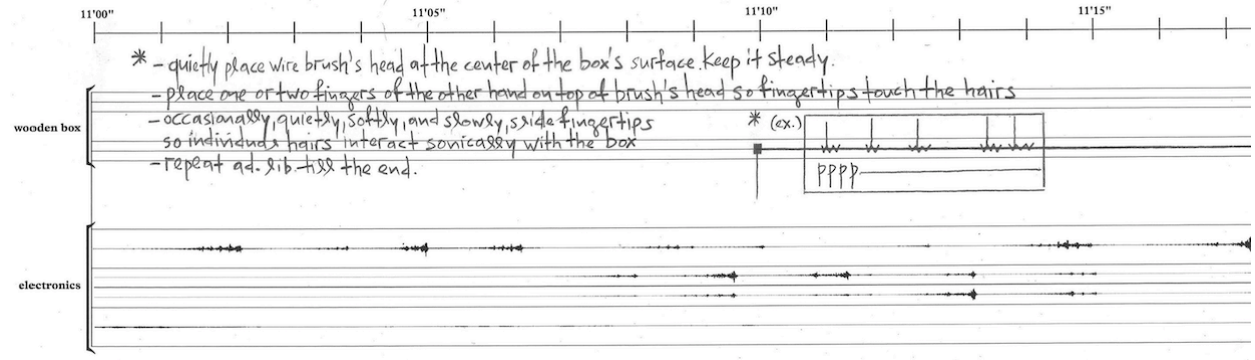


Figure 3.17: Wire Brush on Wooden Box (Page 17 / New Score – Appendix #2)

During the recording process, we recorded page by page. In between takes we would have a back-and-forth exchange of ideas on timings of phrases, if material should be developed further through improvising, and this process of work continued throughout our recording session. For example, as seen in Figures 3.2 and 3.3 above, the first page of the work remained acoustically unchanged from the premiere version. It is also important to note, that at this point in the process the electronic part did not yet exist. While we were going through page by page and recording material, we were also discussing what sound qualities of the electronic

component would work, and where they would exist, and we were taking note of this form as we continued to work.

Another example of this is from Page 2 of the original score (shown above in Figure 3.3), where we felt that the material presented in the first two systems needed more time to unfold and be properly established its significance in the course of the work. Therefore, we proceeded to repeat the particular activity a few more times, slightly changed and developed each time. In the final version, the particular material ended up being elaborated for two more pages (Pages 4 and 5 of the new version of the score – Appendix #2). After the second page of the original score, we continued our process, centering our emphasis on the main focal points that were discussed earlier.

3. Post-Production and Creation of Electronics: Following the completion of the recording sessions, I then began to conceptualize the layout of the work and generated the electronic material that would intersect with the acoustic part. To do this I used multiple platforms, mainly Logic Pro X, in which I laid out the recorded material, to create a skeleton of the work, and continued accordingly until the completion of the piece. Even throughout this stage, I would be sending segments of the occasional outcome as it was gradually being formed to Rebecca to give her thoughts and make contributions to the work. As our collaboration process was integral to all of the previous steps, it felt absolutely necessary to continue that collaboration in the post-production phase. Another subject of our conversation involved the fact of how a performance of this piece would look post this experience, whether the electronics existing as a continuous fixed audio file for the entirety of the piece or the construction and provision of a Max/MSP patch would be the most efficient. Together we felt that a patch would

give future performers the most agency to develop their own relationship with the sonic material and the work as a whole.

4. Making the Score: With the piece being finalized, I then endeavored to notate the new score. Taking from the original version's notation, I adopted many of the same notational practices, yet including an additional double staff at the bottom of the musical system for the layout of the waveform activity of the electronic part. Post the second page of the piece, I had to transcribe what we had developed, continuing this procedure to the completion of the project. Concurrently with the development of the score, I decided where the most appropriate trigger points for the fixed media and the signal processing procedures incorporated in the patch.

3.3 Electronics:

As mentioned previously, the electronic component of the work in its entirety consists of a number of pre-recorded and pre-processed audio files along with moments where the signal of the performer is being processed in real time, and all being projected and spatialized through a stereo system with the two speakers located on stage to the right and left of the performer. A similar approach to *Grit*, all the materials and commands for the operation of the electronic part have been incorporated inside a Max/MSP patch and put in order in a series of cues, which are meant to be activated by the percussionist during the course of the performance.

My approach towards the quality and aesthetics of the electronics was a similar process to which I outline in Chapter 1 regarding my work, *Grit*. Firstly, it was of essential significance for the sonic nature of this electronic layer to have emerged from the pure matter of the sonic qualities performed by the instrumentalist – the electronic sounds coming from the acoustic and vise versa. When creating the electronics, I was seeking to embrace and filter the sonic presence coming from the objects and extend further the sonic capabilities they offer. In addition, and in

communication with Rebecca, it was vital for us to be conscious of the relationship between the acoustic and the electronic components, and, therefore, we set to create a number of different scenarios in the way the two interact with each other. During the course of the piece, we see moments, such as the beginning, where the percussionist leads, while the electronics timidly interfere as in an accompanying mode. We were also presented with moments such as the ending, where the two entities contribute with the same high level of activity until the performer gradually drops out, offering the ground to the electronics to dominate. This dialogue is integral to the aesthetic of the work.

Regarding the construction process of the piece, in contrast with *Grit*, the electronic part in *minute | from within* did not provide the infrastructure upon which the acoustic part was composed. Rather, having already the scheme of the piece formalized with the recordings of the percussionist, the electronics were made and applied upon that acoustic skeleton. This stage in the process was initiated by determining the moments I felt the electronic presence was needed to interfere, approaching the musical narration already formed by the acoustic part moment by moment, quite intuitively and instinctively.

After deciding the points where I wanted the electronics to act and having formulated some ideas regarding the durations of their activity as well as their timbral character, I proceeded with the third stage of my *Sound Sculpting* procedure, *Sound Manipulation*.

3.3.1 Sound Manipulation:

Utilizing all the methods of sound manipulation discussed in the previous chapters – from cleaning my sounds, to modifying the temporal, frequential, timbral, and spatial dimensions of them, as well as applying additive synthesis procedures with a combinatory network of processes

occurred upon a single sound – I began experimenting with the recorded sonic data Rebecca had performed during the first recording session.

As an example, for the first 11 cues[24], the electronic part presents different variations of sonic activity of the performer's fingertips interacting and sliding across the skin of the bass drum. These several occurrences have been slightly modified, proposing alternative outcomes through the basic procedures of stretching their temporal frame and disseminating the part of spectrum they exist on. In Cue #6, in the second audio file, I manipulated the parameter of amplitude, creating a crescendo in an effort to provide a sense of drive and of raising of intensity. In addition, two examples of reversing the activity occur in Cues #10 and #11, where the former activates two repeated occurrences of a reversed comb scrape articulated upon the surface of the wooden box, and in the latter a simple bass drum hit is played backwards. The musical intention here presents a similar effect to the artificial gradual amplitude raise in the second sound file in Cue #6.

Figure 3.18: Waveform of Reversed Bass Drum Hit Activity (Cue #11)

An example of a more elaborated process of modification of the pitch content of a sound is heard in Cue #22. The original audio file that went through a manipulation procedure was that of a simple gesture of a superball dragged across the skin of the bass drum. Willing to give a

[24] Throughout this chapter, cue numberings refer to the cue numbers in the score of *minute | from within* attached as Appendix #2.

sense of a momentary closure to the particular part of the musical activity, my purpose was to create a gesture that would incorporate a sense of descend. Utilizing the sound produced by the superball, I first shaped the length of the sound to the desired duration and then divided that duration into 5 smaller segments. Initiating a pitch shifting process to each of the segments, starting with a higher pitch, the phrase is lead step by step down to the originally recorded frequency in the form of a descending glissando.

The audio files of the original and modified sounds of Cue #11 and #22 can be heard here:
www.theocharis-papatrechas.com/dissertation-audio-7

In an effort to further empower the micro finesses of the sonic palette I was working with, granular synthesis could not be a better tool for sound manipulation in this context. Once again, I made use of the granulator *munger* seeking to dismantle the sonic matter of my sounds into tiny fragments. An instance granular synthesis takes place is found in Cue #13. The audio file being processed includes the sound of a plastic stick producing some consecutive gestures gently interacting with the surface of the pipe. In this case, Preset #8 (as presented in Table 1.2 in Chapter 1) was utilized, with the only difference that the parameter of pitch was varied by 0.25, which expanded the resulting frequency spectrum by one semitone. This instance presents a proper example of the general intention I was preoccupied with regarding the electronics, according to which the electronic material purposes to emerge from the acoustic part; the performer initiates the activity by sliding her fingertips on the surface of the pipe, and the electronics, not only imitate the acoustic activity, but take the process a step further by extending its musical potentiality and dimensionality with the interference of the granulation and the expansion of the frequency spectrum.

Another use of the *munger* granulator is heard in Cue #26. The sound of a single hit on the flowerpot is going under the process of granulation. Initially looping the sound, I then ran *munger*'s Preset #8 on the repeated flowerpot articulations. In this case, I modified the pitch content to be pitch-shifted an octave higher with the "Grain Pitch" attribute reading "2". By granulating the sonic behavior of the even repetitions, the process adds to the outcome an element of imbalance, randomization, and unpredictability, dismantling again the activity into fragments of sonic matter and scattering them unevenly in time.

The audio files of the original and modified sounds of Cue #13 and #26 can be heard here:
www.theocharis-papatrechas.com/dissertation-audio-8

Preset #8 is used to process the signal of the performer in real time in the section starting with the superball gesture on the pipe (Page 6 of the score) all the way to the bass drum part beginning in Page 10 of the score. The live signal processing in this section attempts to add to the complexity of the already intense texture resulting from the interaction between the several elaborate gestures of the performer on the box and pipe with the different fixed media triggered along the way.

Lastly, concepts of utilizing the terminology "active" and "inactive" – as presented in the case of *Pythmenas* – to characterize the several fluctuations that occur in the parameter of intensity throughout the course of the piece was also considered here to represent the interactivity between the two protagonists (the acoustic and the electronic). Therefore, six main parts (as seen in table 3.1 below) are formulated where the two components are given different roles. The part division is firmly associated with the formal scheme of the piece as determined by the six anchor points discussed previously in this chapter.

Table 3.1: Form / Anchor Points / Components' Interactivity

Part	Score	Anchor Point	Acoustic	Electronic
1	Pages 1-5	"First 2 Pages"	Active	Inactive
2	Pages 6-9	"Superball on Pipe"	Inactive	Active
3	Pages 10-13	"Dish Brush on Bass Drum"	Active	-
4	Pages 13-14	"Patterns"	Inactive	Inactive
5	Pages 15-16	"Elaborate Gestures"	Active	Active
6.1	Pages 16-18	"Wire Brush on Box"	-	Active
6.2	Page 18		Active	-

3.3.2 Spatialization and Sonic Spaces:

Being considered a highly significant component of the composition, spatialization in *minute | from within* is primarily concerned with the element of sound movement in space. As in *Grit*, this work also operates with two main types of spatial motion – *direct* and *irregular* – as well as a combinatory version of the two laid out upon a single musical phrase/gesture. Below, Figures 3.19 through 3.24 present three examples from the sonic activity heard in Cues #18, #16, and #28, upon which have been applied the three distinct motion types. Following Figure 3.21, the link directs to the audio files of the three examples.

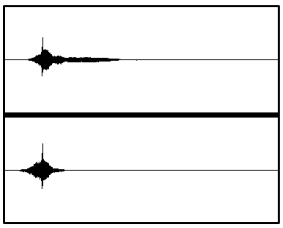


Figure 3.19: Waveform of Activity in Cue #18

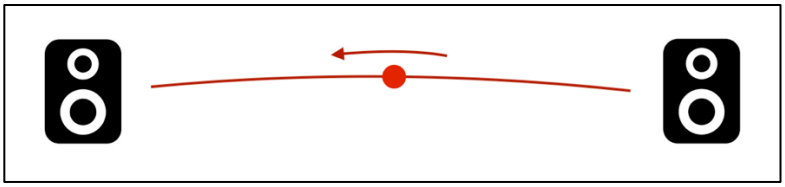


Figure 3.20: *Direct* Spatialization Trajectory of Activity in Cue #18

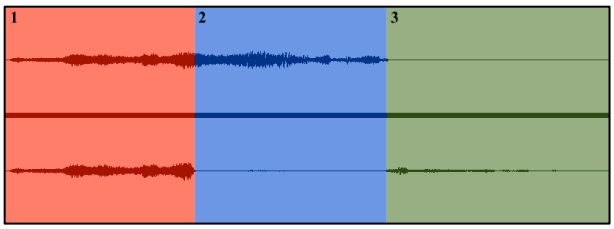


Figure 3.21: Waveform and Division of Activity in Cue #16

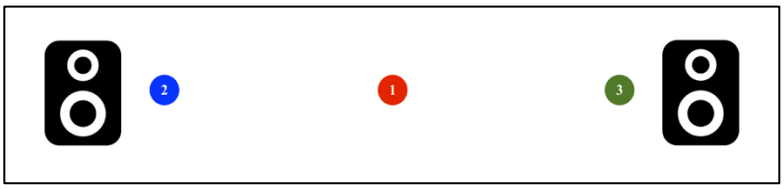


Figure 3.22: *Irregular* Spatialization Trajectory of Activity in Cue #16

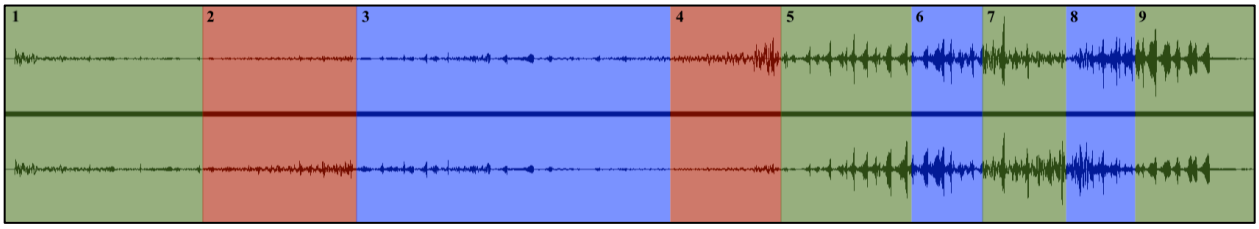


Figure 3.23: Waveform and Division of Activity in Cue #28

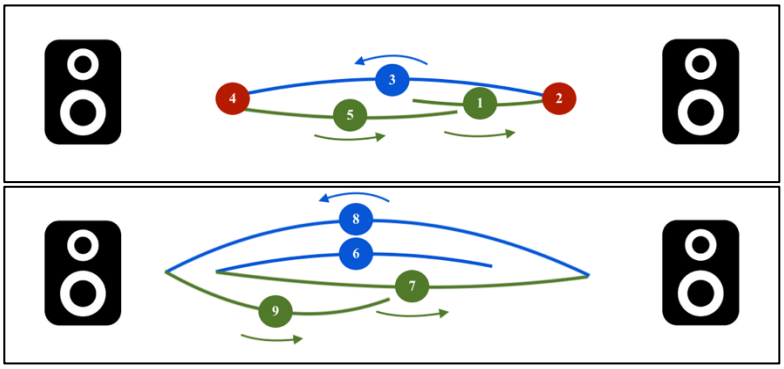


Figure 3.24: Elaborate *Irregular* Spatialization Trajectory of Activity in Cue #28

Audio files with the different types of motion in Cues #18, 16, 28 can be heard here: www.theocharis-papatrechas.com/dissertation-audio-9

Apart from the way sound moves in space, I gave special emphasis on the quality of the space the projected sounds exist in throughout the course of the work. By taking the component

of space into consideration in the compositional process, my intention was to add another level of dimensionality to the outcome by developing further the idea of the amplifying objects. With the objects' signals being empowered via microphones placed inside their bodies, the electronics purpose not only to highlight the micro sonic details of these distinct resonant chambers but, over the duration of the piece, to modify these spaces proposing alternative sonic spaces. This process occurred by the manipulation of the parameter of reverberation and, more specifically, the adjustment of the attributes of "room size", "predelay time", and "reverberation time", and the ratio of the raw to the processed signal in the output.

Throughout the piece, I made use of four different of the above mentioned sonic spaces. The first one involves the raw signal of the objects as initially recorded without the application of any type of spatial processing. The second type with 0ms of predelay time, 1.5 second of reverberation time, and 80/20 the ratio of dry/wet signal, is mainly applied on the signals of all the four objects in an effort to expand and strengthen their body of sound. The third type works with 10ms of predelay time, 2.5 seconds of reverberation time, 65/35 of dry/wet ratio, and doubling the original room size. Lastly, the fourth type increases the quality of reverb with 15ms of predelay, 3 seconds of reverberation time, 50/50 of dry/wet ratio, and quadrupling the room size.

All four are used in the files in the electronic part. Overall, the distribution of the types occurs gradually and linearly with the order that were presented above. For instance, for the first 12 cues, the electronics do not make use of any spatial intricacies and are being played back as originally recorded. The first audio file presented through a different sonic space is activated in Cue #13 where the second type is applied gradually, matching the spatial quality of the acoustic

part. The link below provides a demonstration of the four distinct types of sonic spaces using as example the activity triggered in Cue #2.

 The audio files demonstrating the four distinct types of *sonic spaces* can be heard here: www.theocharis-papatrechas.com/dissertation-audio-10

In conclusion, *minute | from within* is a work that is not dissimilar to the works mentioned in chapters one and two, however, the process of creation differed greatly. Through an honest and collective collaboration, I believe that the work achieved in creating and presenting this composition attempts to break down the composer performer paradigm commonly seen throughout the twentieth century and acts as an innovative way to approach collaboration. By letting go of the norms and expectations I had of how-to compose and engage with performers, I have been fortunate to embark upon a process of creation, process and notation that is invigorating and essential for my practice moving forward.

Conclusion

Within this dissertation I have presented my methodology and process in composing works for acoustic instruments and electronics. Through this exploration I have discussed the principles with which my current compositional work is preoccupied, including the elements of dualism, oppositionality, fragmentation, granularity, and space, and attempted to develop a creative syntax relating to my work. Throughout the three chapters of this dissertation, I focused on a single project/composition per chapter and went into great analytical and ontological detail as to the process and context of each piece.

In Chapter One, I detailed the fusing of the sonic worlds of piano, percussion, and electronics through my composition, *Grit.* I outlined my process of recording and the elements within the Max/MSP patch in which I developed. Throughout Chapter Two, I gave a detailed and analytical analysis of my compositional and electronic process in my work *Pythmenas* and spoke about my collaborative process with the four of my UCSD performance colleagues. Chapter Three provided a comprehensive analysis of my work *minute | from within.* Throughout this chapter, I attempted to detail the importance and integral role collaboration played in the creation of the work. By detailing the intimate and in-depth collaboration process, I outlined the dissemination of the traditional composer-performer paradigm.

In addition to this, I have provided insight into the processes undertaken for the formulation of the materiality of both the acoustic and electronic entities in my work – the synergy of electronic and acoustic forces. Special emphasis was given to the practice of *sound sculpting*, outlining the meticulous work I endeavored to engage in relating to the sonic material, from its discovery, to its recording, and subsequently the electronic manipulation. Additionally, each chapter outlined my approaches and fascination with *spatialization*; a practice that in my

work deals with not only the movement and diffusion of the electronic sounds in space, but also the constant modification of the spatial dimension of these sounds in an effort to provide the listener the opportunity to experience distinct types of *sonic spaces* during the performance.

In my future work, I am envisioning to continue to develop further the practices mentioned in this dissertation, and to continue to develop my creative voice, synergizing all of my autonomous creative outputs that play a vital role to my artistic identity. Further exploration of the roles and potentialities of the practice of *sound sculpting* are of crucial importance to my work, as is the integral component collaboration has played in the development of my projects.

APPENDIX

Appendix #1: Score of *Grit*

Theocharis Papatrechas

grit

for piano, fixed media, live electronics, and sound diffusion

2019

grit (2019)

for piano, fixed media, live electronics, and sound diffusion

written for and heartily dedicated to Dimitris Paganos Koukakis
premiered in November 2019 at the University of California, San Diego (UCSD)

Duration: 15' ca

PERFORMANCE NOTES

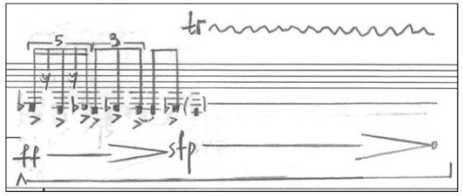
Needed Items:

- 1 Plastic Card / Credit Card
- 1 Large Coin (preferably the 10 Mexican Peso or the 2 Euros)
- 2 Medium Marimba Mallets
- 1 Triangle Beater
- 1 Thick Metal Stick (e.g. long thick screw)
- 1 Bongo - placed on the pegs of the middle register
- 1 Small Chinese Tom-tom - placed on the pegs of the middle register
- 1 Tile with gritty surface - taped on the pegs of the lower register
- 2 Super-balls – a large and a small
- 2 Batches of Bow Hair
  - -1 placed to bow **Ab1**
  - -1 placed to bow **D1** and **Eb1** combined
- Rubber Piano Mutes to mute the following notes (a couple of mutes may be needed for one note): **E1, F1, Gb1, G1, A1, Bb1**

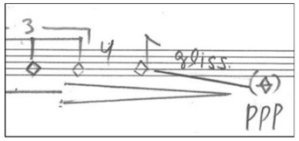
Picture depicting the ideal placement and positions of the various instruments/objects (i.e. tile, drums, bow hair batches) inside the instrument as well as the microphones

Notation:

Already muted notes appear with squared note-heads
(Excerpt from page 1 / system 1)

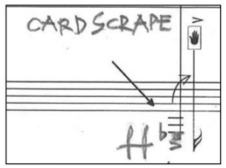


Whenever the performer interacts with the strings in various ways, the notes appear with empty diamond note-heads
(Excerpt from page 3 / system 2)

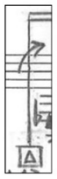


Page 1 / System 1:
Using the coin, hit any of the metal bridges inside the piano

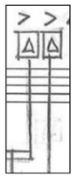
With left hand scrape the string of Gb1 and with the right hand's palm with the strings of the middle register



Page 1 / System 2:
Using the triangle beater, scrape the strings of the low register moving from left to right



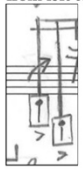
Using the triangle beater, hit any of the metal bridges of the piano



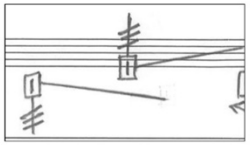
Page 2 / System 1:

Using the mallet, hit the wooden part of the body at the right wall of the instrument

Using the mallet, at first, scrape the strings of the low register moving from left to right and then hit the lower strings



With the wooden end of the mallets, begin with the left hand in the middle register sliding downwards and then with the right hand slightly higher slide upwards



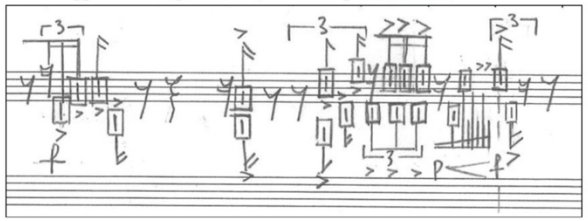
Page 6

The first bow hair batch should be placed to bow note Ab1 and the second one should be placed to bow both D1 and Eb1. Both hands needed to bow the strings.
For the better understanding of how to operate the bow hair batches and of the entirety of the particular section, please refer to the section 5'41"-7'20" of the video

Page 7 / System 1

With the rubber ends of the pencils, tremolo on the particular string

Holding the pencils parallel to the strings, hit so that the surface of the pencil hits several notes. The position of the 'noteheads' indicate approximate registral area (video excerpt: 7'42"-7'48")



For further information regarding the demonstration of the various techniques used in the piece and the sonic outcome, please visit the video from the premiere:

https://youtu.be/cveSYNU8Wf8

Individual page links for quicker access:

Page 1 (0'24") | **Page 2** (1'25") | **Page 3** (2'25") | **Page 4** (3'32") | **Page 5** (4'47") | **Page 6** (5'41") | **Page 7** (7'29")

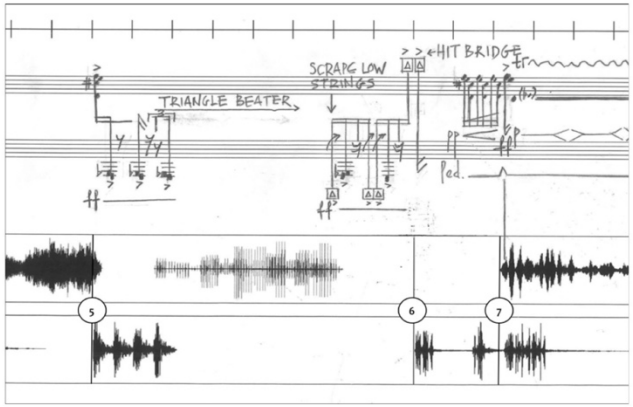
Page 8 (8'28") | **Page 9** (9'20") | **Page 10** (10'17") | **Page 11** (11'14") | **Page 12** (12'27") | **Page 13** (13'54")

ELECTRONICS

The electronic component of the work consists of prerecorded media being triggered during the course of the piece as well as moments of digital signal processing, in which the incoming signal captured by microphones placed inside the piano is being processed through various granulators. The output signal, following specific spatialization trajectories, is being diffused within an octophonic (8-channel) system circularly surrounding the audience.

The prerecorded media as well as the instructions with regard to signal processing and spatialization have all been input inside a Max/MSP patch and laid out in 60 distinct events. The events have been notated under circled numbers in the electronic part of the score. An electronic musician or the composer, who should be located off stage, needs to operate the patch triggering the distinct events following the performance in real time.

(Excerpt from **page 1 / system 2** of the score – events notated in circled numbers)



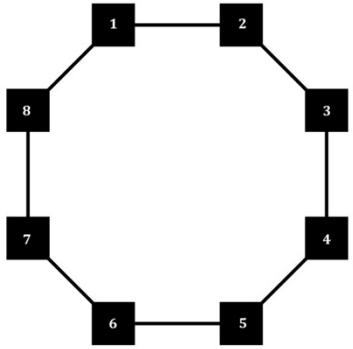
A complete Max/MSP patch is to be provided by the composer.

Technical Rider:
• 8 Surround Loudspeakers
• Mixing board

• 2 Omni Directional Small Diaphragm Condenser Microphones (e.g. Audio-Technica's AT4022)
  -1 placed close to the hammers of the low register on the left side facing the instrument
  -1 placed close to the hammers of the high register on the right side facing the instrument
• Sound interface: 8 inputs-outputs
• MacBook Pro Computer
• Max/MSP 8
• IRCAM external: Spat 5.1*
• Midi Controller

*provided by the composer

Configuration setup:



Cabling:
The 8 speakers should be connected to the 8 first outputs of the sound interface.
The 2 microphones should be connected to the first 2 inputs of the sound interface.

Initializing Max/MSP:
1. Move folder "papatrechas_grit" to Desktop
2. Move folder "spat5.1" to: Documents/Max 8/Packages
3. Launch Max8
4. Audio Status Setup:
    -Go to menu **Options** —> **Audio Status** —> **Driver** (*select the one which is related with the sound interface that is connected to the laptop*)
    -Input and Output device should match
    -Sampling rate (**44100** or **48000**)
    -I/O vector size (**512**)
    -Input: **Ch1 = 1 Input 1 | Ch2 = 2 Input 2**
    -Output: **Ch1 = 1 Output 1 | Ch2 = 2 Output 2 | Ch3 = 3 Output 3 | Ch4 = 4 Output 4 | Ch5 = 5 Output 5 | Ch6 = 6 Output 6 | Ch7 = 7 Output 7 | Ch8 = 8 Output 8**
5. Directories:
    -Go to menu **Options** —> **File Preferences…**
    -Choose the folder: Documents/Max 8
    -Choose the folder: Desktop/papatrechas_grit
    (make sure the "x" for the subfolders of both folders is selected)

Initializing the patch:
1. Double-click to open patch "papatrechas_grit_MAIN.maxpat"
2. Open Sound
3. Initialize Settings
4. Open Mics
5. Space-bar for Cue 1…

Make sure to check for errors in Max Console (menu **Window** —> **Max Console**)
Restart Max if necessary.

Midi Controller:
Due to the fact conditions differ from performance to performance (e.g. space size, sound absorption, equipment etc), it is encouraged the person operating the electronic component performs levels throughout the course of the piece, especially with regard to live signal processing. In this case, a midi controller with at least 6-8 faders is needed (ex. Korg's nanoCONTROL2).

Main Patch Image:

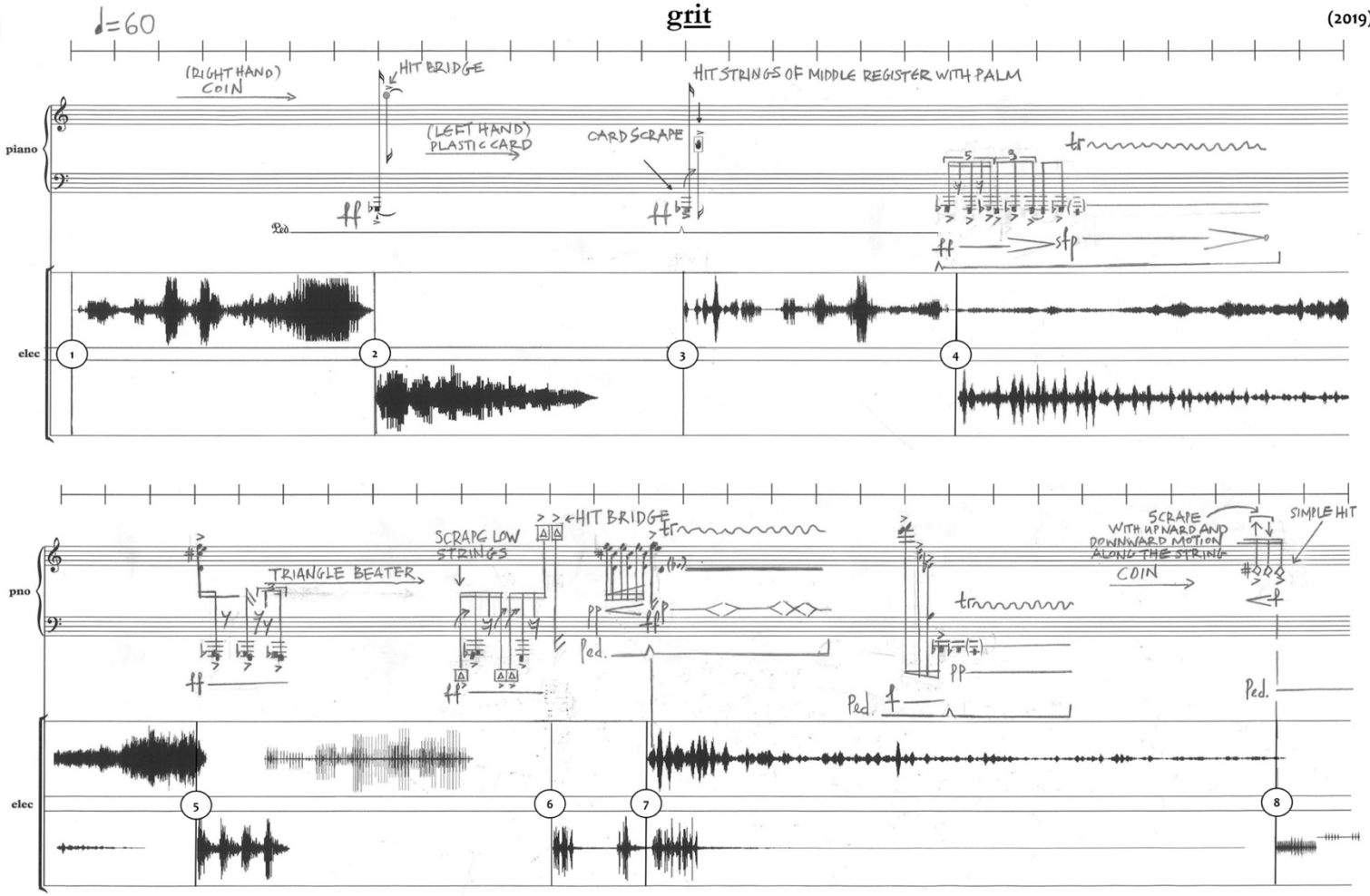
To be provided with the patch and for more details about the piece, the electronics, and the proper operation of the patch, please, get in touch with the composer.

Theocharis Papatrechas
+1-925-914-7460
hpapatrechas@gmail.com

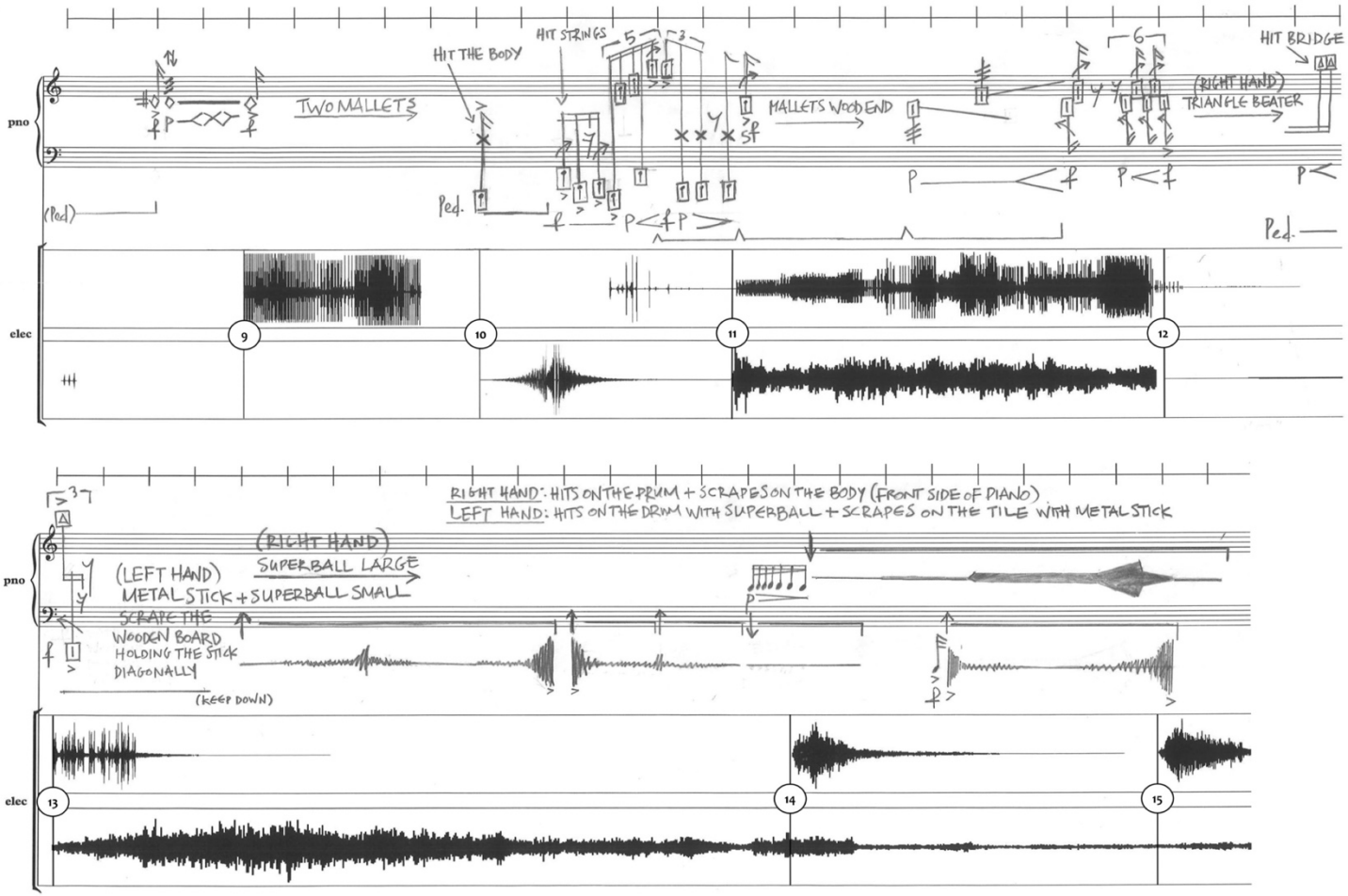
1

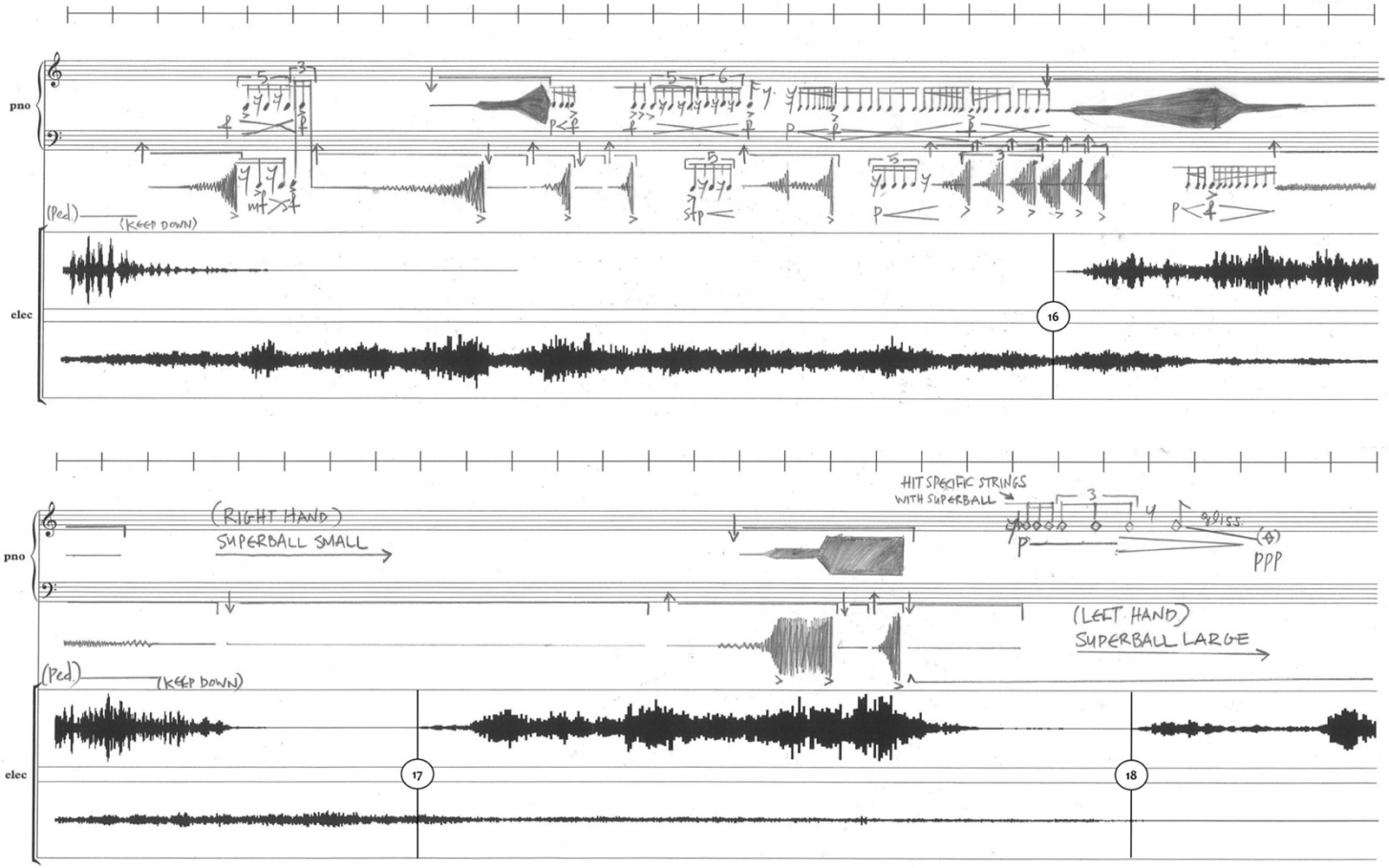
grit

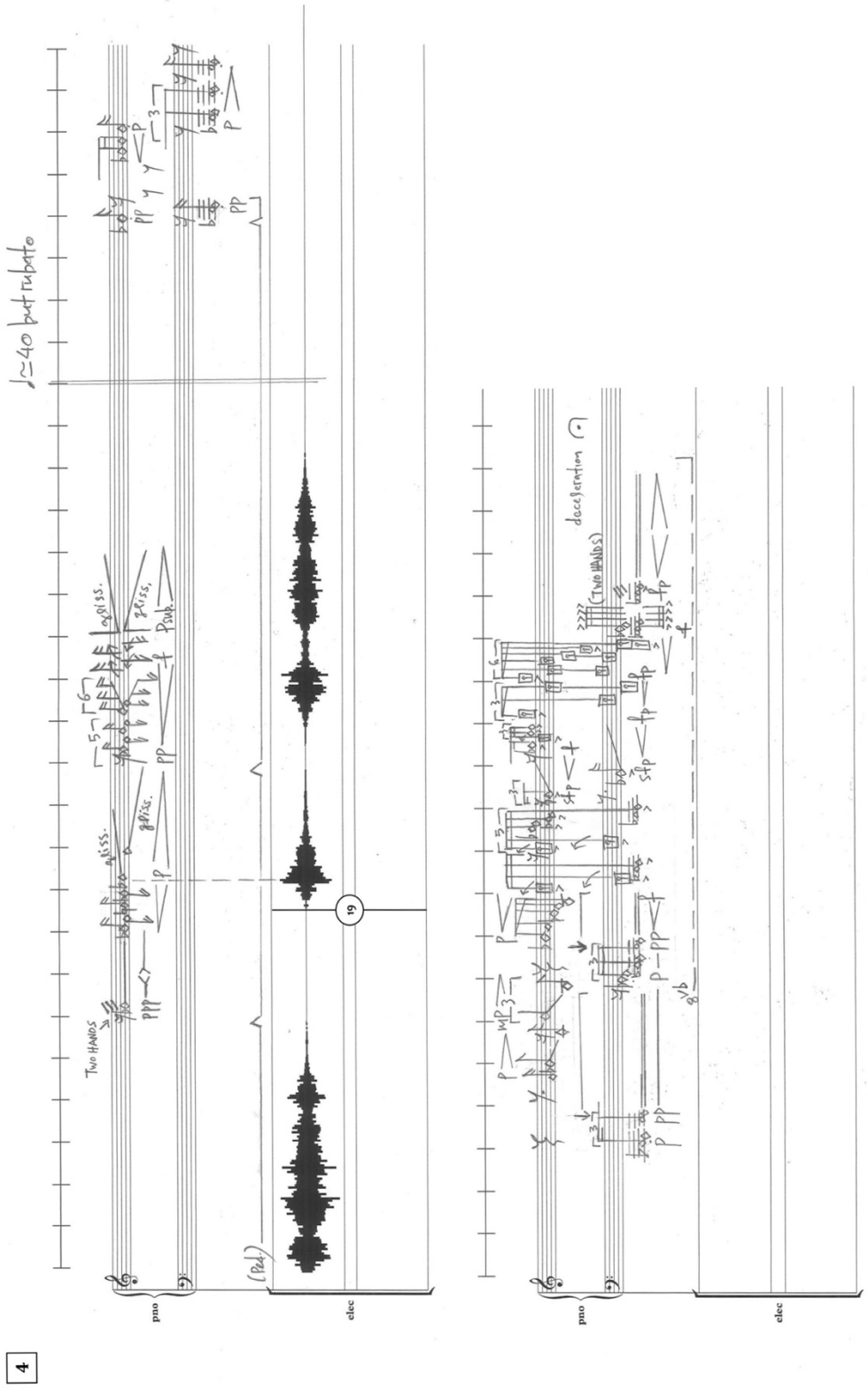
(2019)

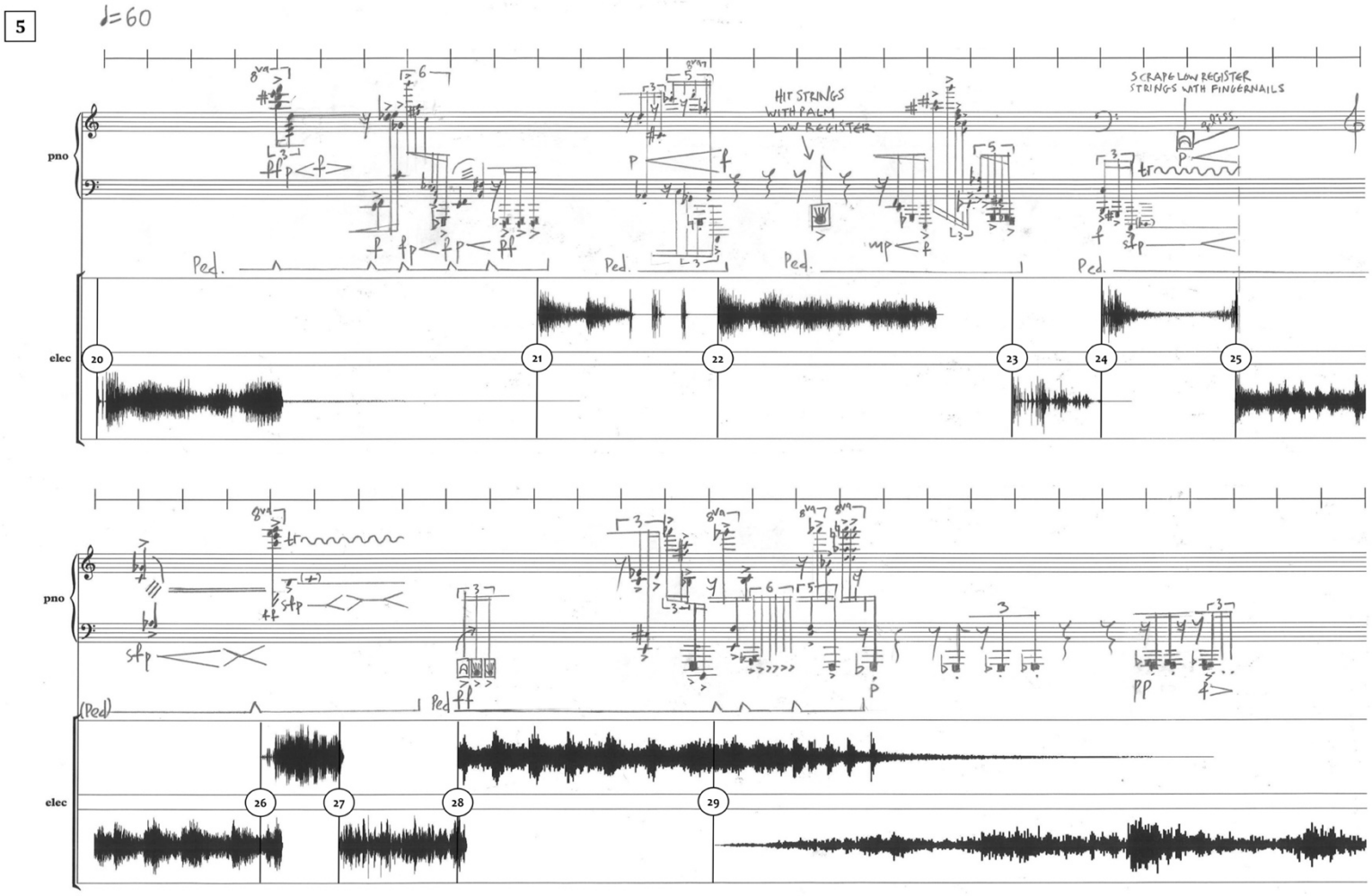

♩=60
(RIGHT HAND) COIN
HIT BRIDGE
HIT STRINGS OF MIDDLE REGISTER WITH PALM
(LEFT HAND) PLASTIC CARD
CARD SCRAPE
piano
Ped.
elec
1
2
3
4
TRIANGLE BEATER
SCRAPE LOW STRINGS
HIT BRIDGE
SCRAPE WITH UPWARD AND DOWNWARD MOTION ALONG THE STRING
SIMPLE HIT
COIN
pno
Ped.
5
6
7
8

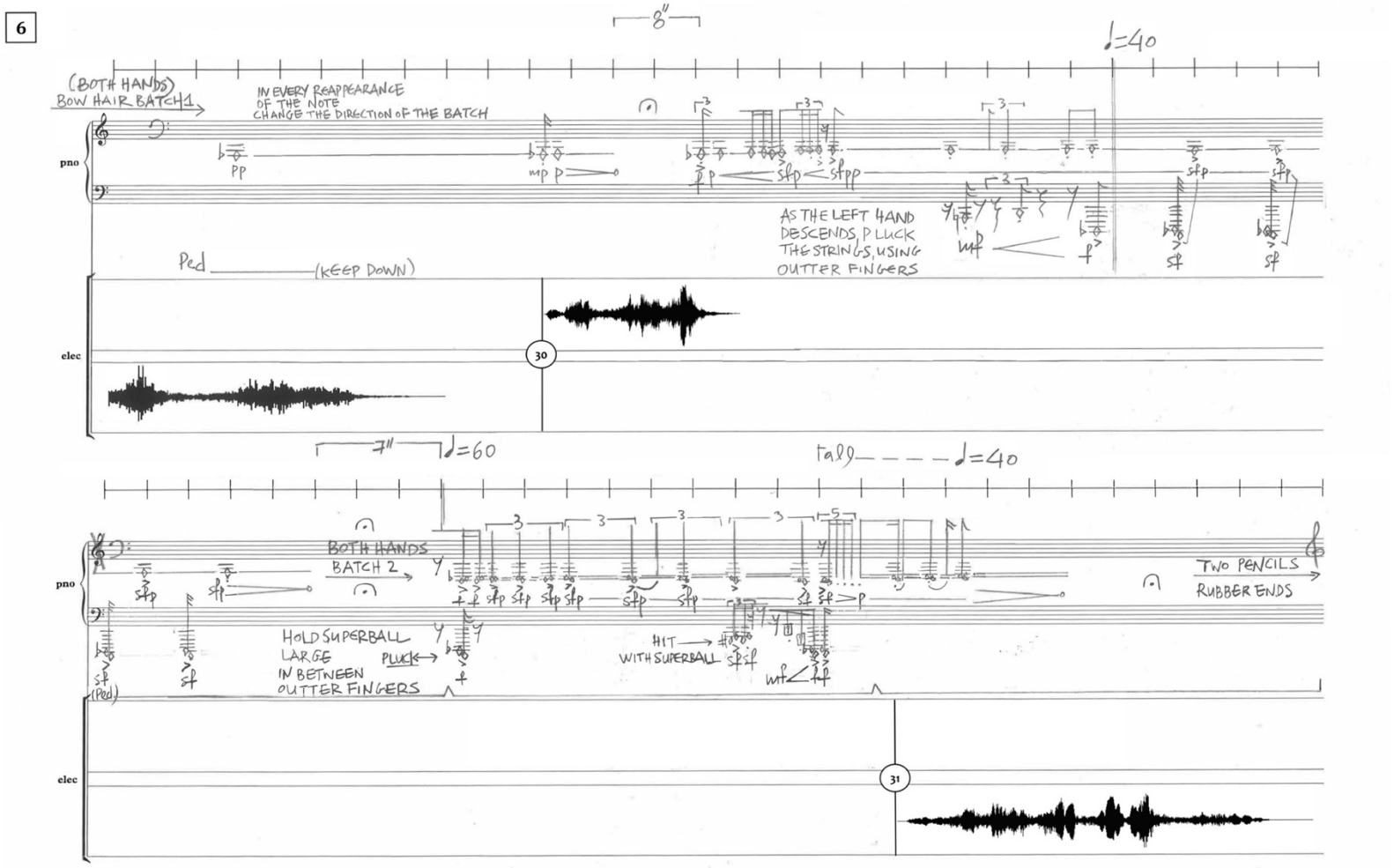
2

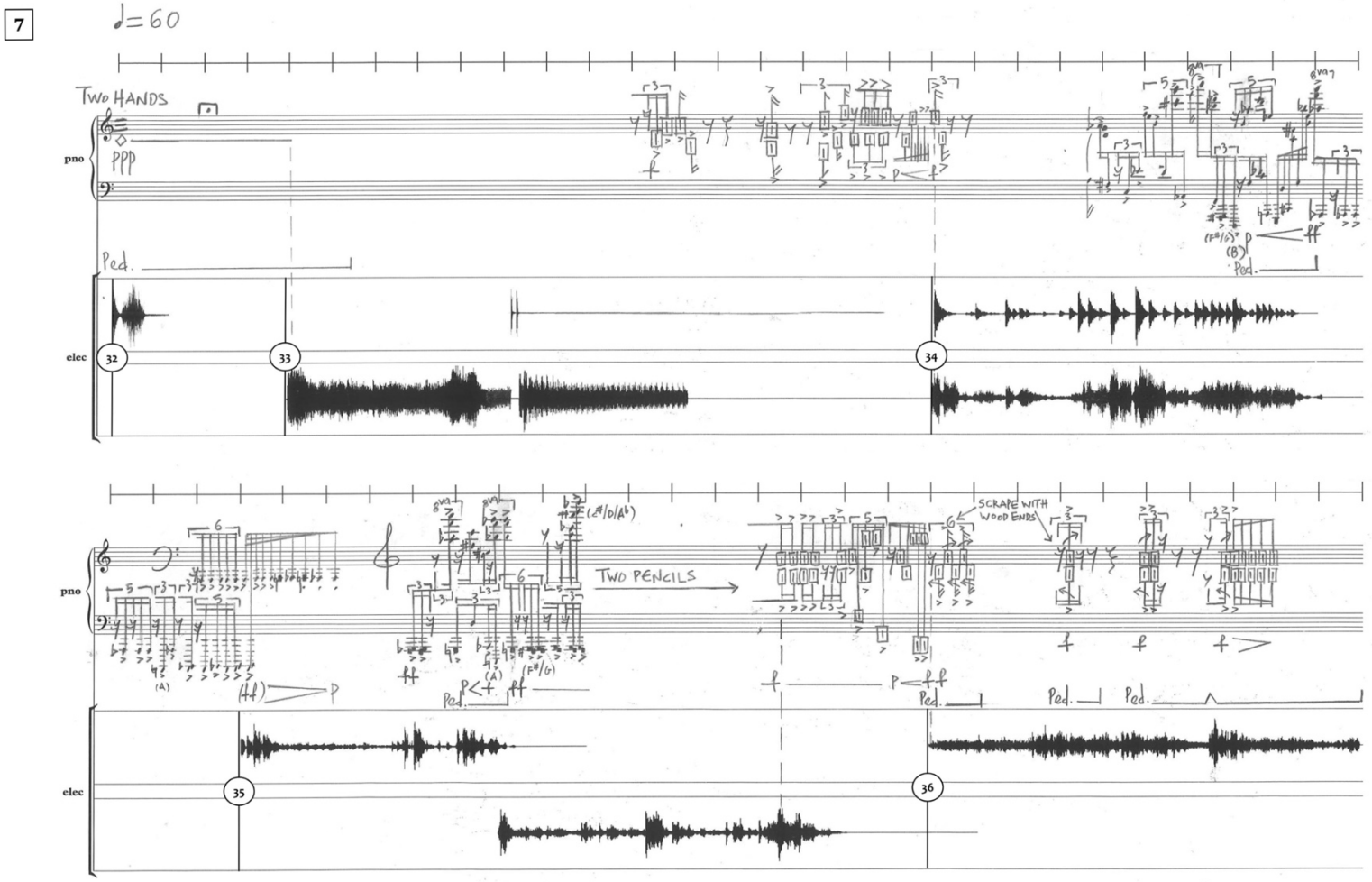

pno
TWO MALLETS
HIT THE BODY
HIT STRINGS
MALLETS WOOD END
(RIGHT HAND)
TRIANGLE BEATER
HIT BRIDGE
(Ped.)
Ped.
elec
9
10
11
12
RIGHT HAND: HITS ON THE RIM + SCRAPES ON THE BODY (FRONT SIDE OF PIANO)
LEFT HAND: HITS ON THE DRUM WITH SUPERBALL + SCRAPES ON THE TILE WITH METAL STICK
(RIGHT HAND)
SUPERBALL LARGE
(LEFT HAND)
METAL STICK + SUPERBALL SMALL
SCRAPE THE
WOODEN BOARD
HOLDING THE STICK
DIAGONALLY
(KEEP DOWN)
13
14
15

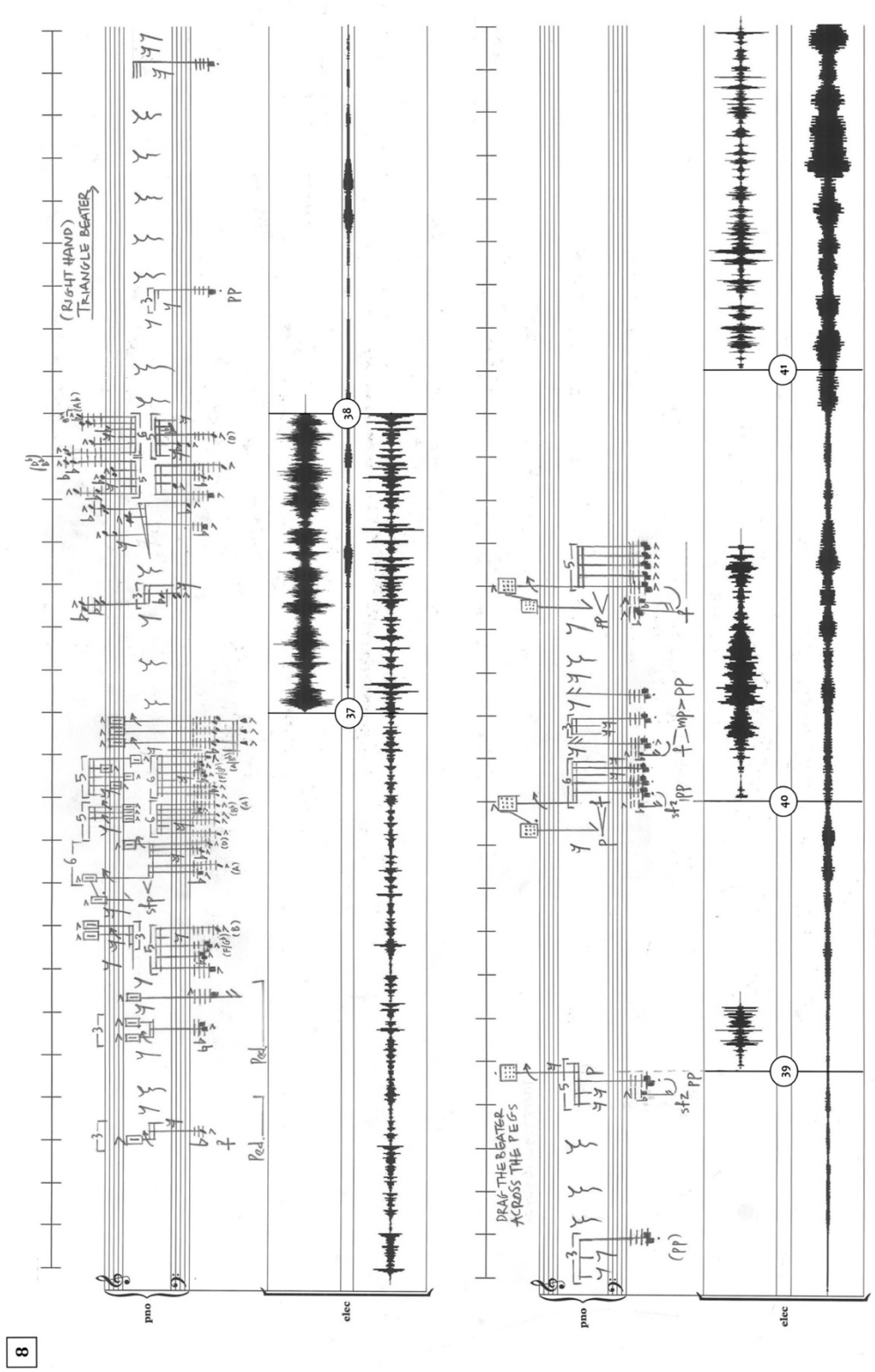

pno
(Ped.)
(KEEP DOWN)
elec
16
HIT SPECIFIC STRINGS
WITH SUPERBALL
(RIGHT HAND)
SUPERBALL SMALL
PPP
(LEFT HAND)
SUPERBALL LARGE
17
18

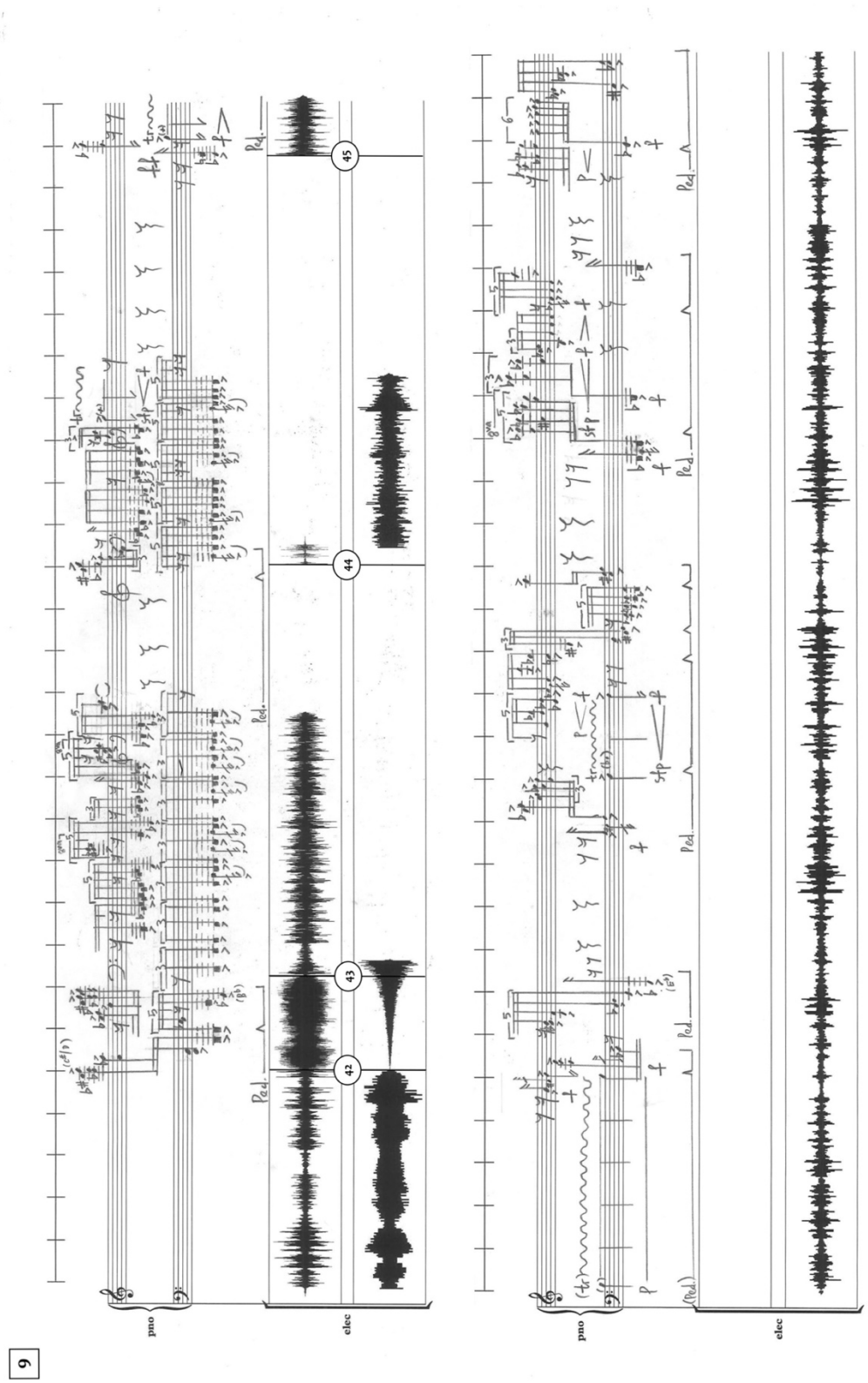

♩=40 but rubato
Two HANDS
(Two HANDS)
decelerando
(Pad)
19
pno
elec
pno
elec

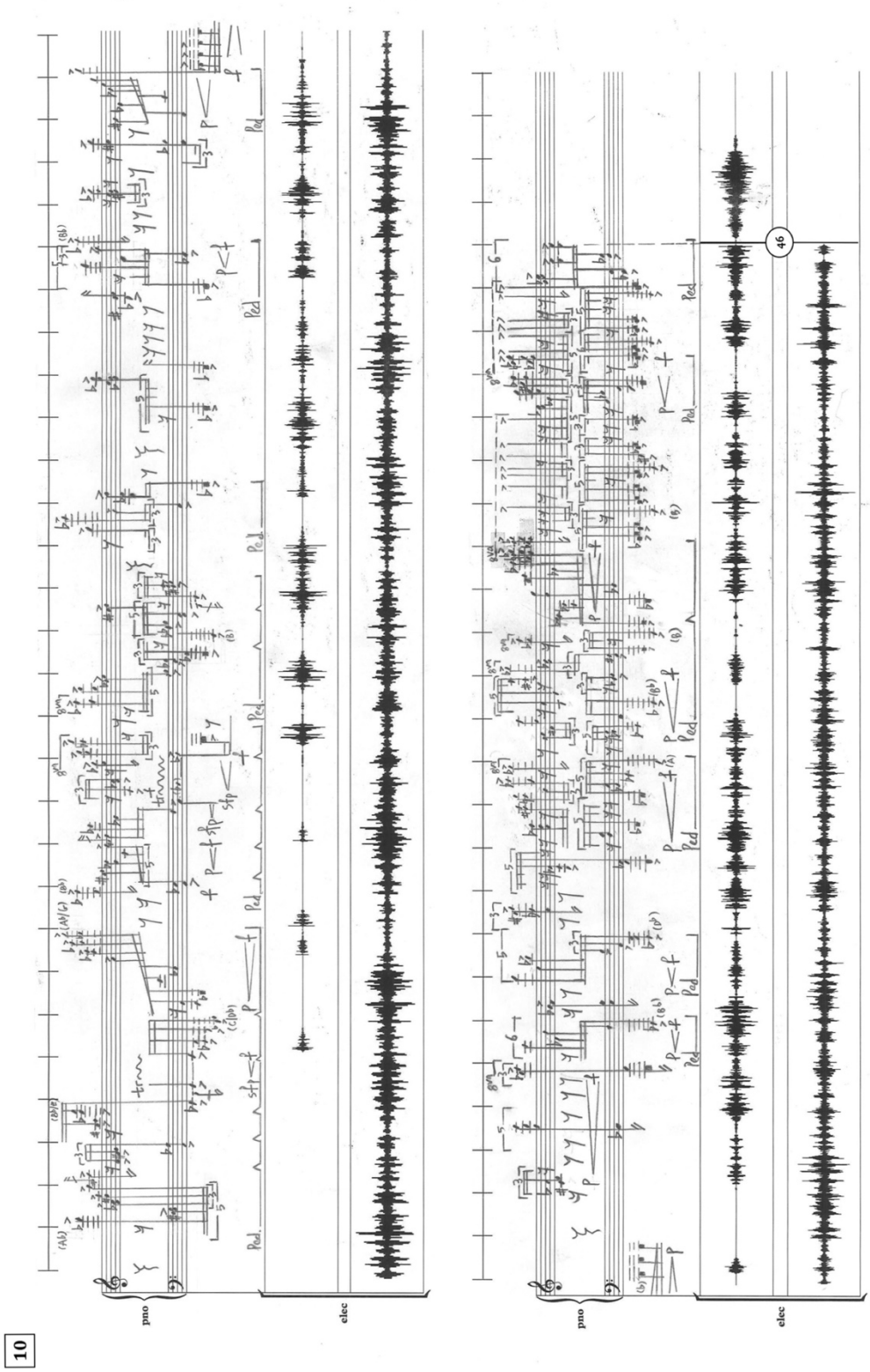

5
♩=60
pno
elec
HIT STRINGS WITH PALM LOW REGISTER
SCRAPE LOW REGISTER STRINGS WITH FINGERNAILS
Ped.
(Ped)
20
21
22
23
24
25
26
27
28
29

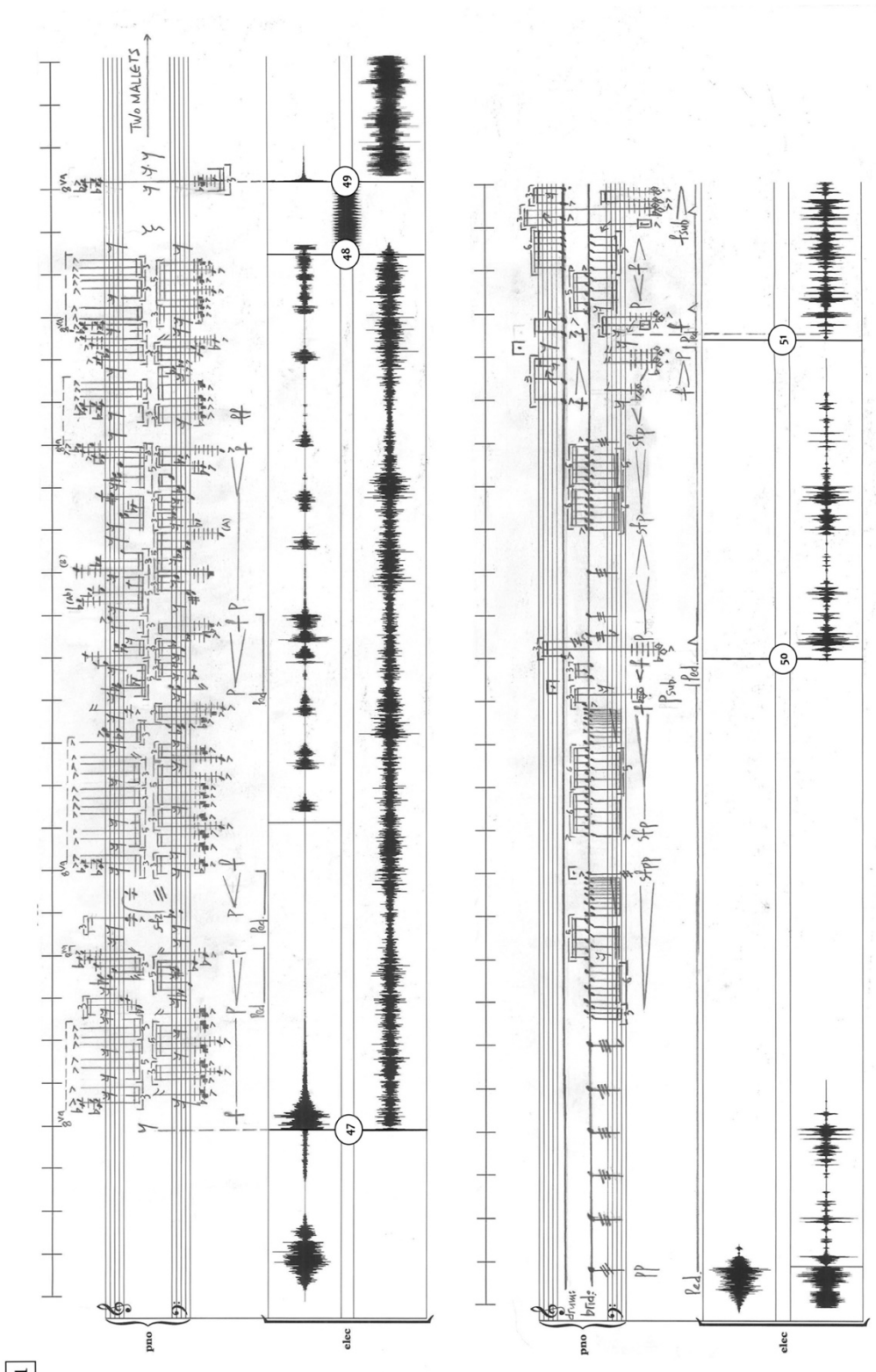

6
8"
♩=40
(BOTH HANDS)
BOW HAIR BATCH 1
IN EVERY REAPPEARANCE
OF THE NOTE
CHANGE THE DIRECTION OF THE BATCH
pno
PP
mp
p
sfp
sfpp
AS THE LEFT HAND
DESCENDS, PLUCK
THE STRINGS, USING
OUTTER FINGERS
mf
f
Ped (KEEP DOWN)
elec
30
7"
♩=60
rall
♩=40
BOTH HANDS
BATCH 2
HOLD SUPERBALL
LARGE
IN BETWEEN
OUTTER FINGERS
PLUCK
HIT
WITH SUPERBALL
TWO PENCILS
RUBBER ENDS
(Ped)
31

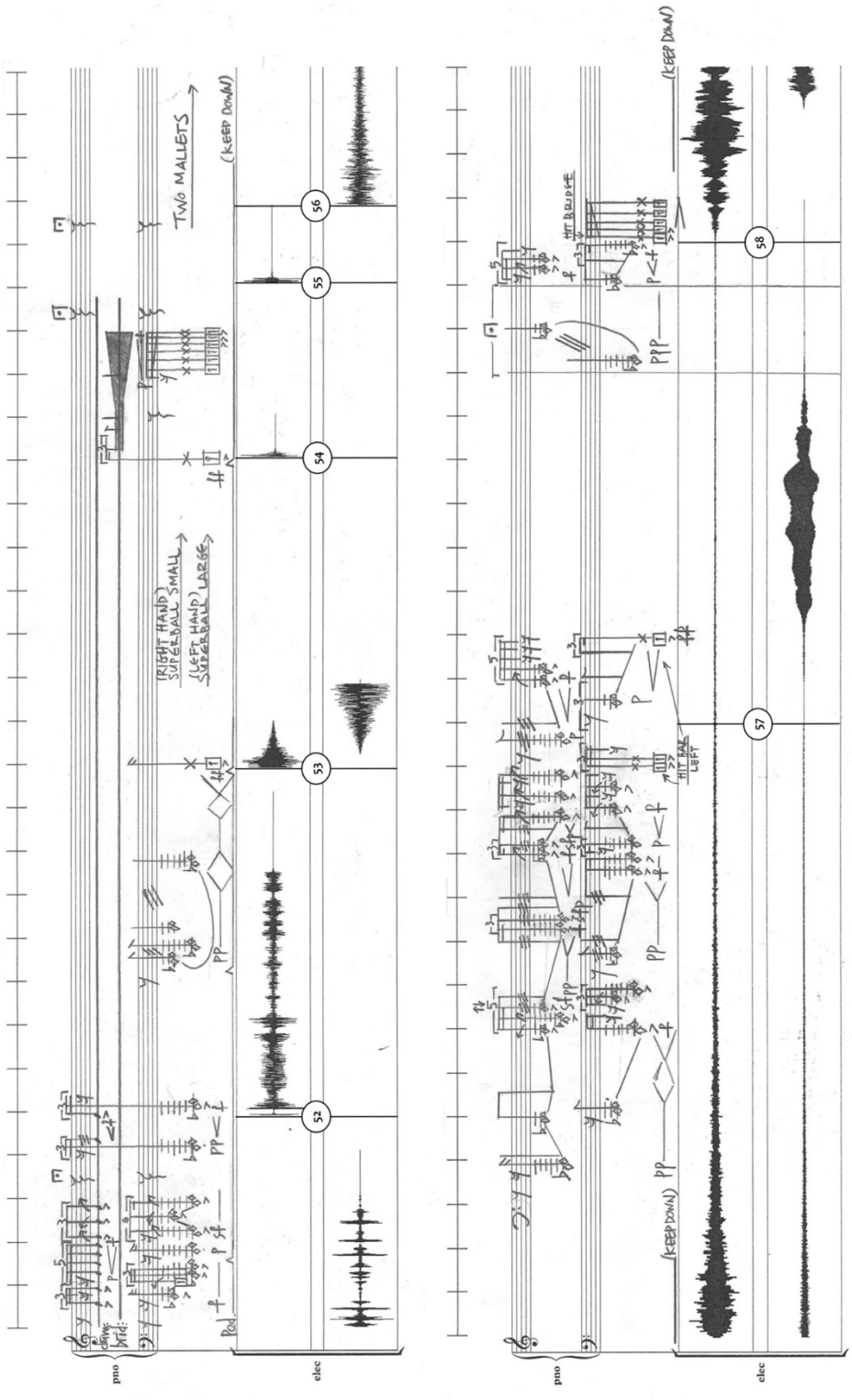

7
♩=60
TWO HANDS
pno
PPP
Ped.
elec
32
33
34
TWO PENCILS
SCRAPE WITH WOOD ENDS
35
36

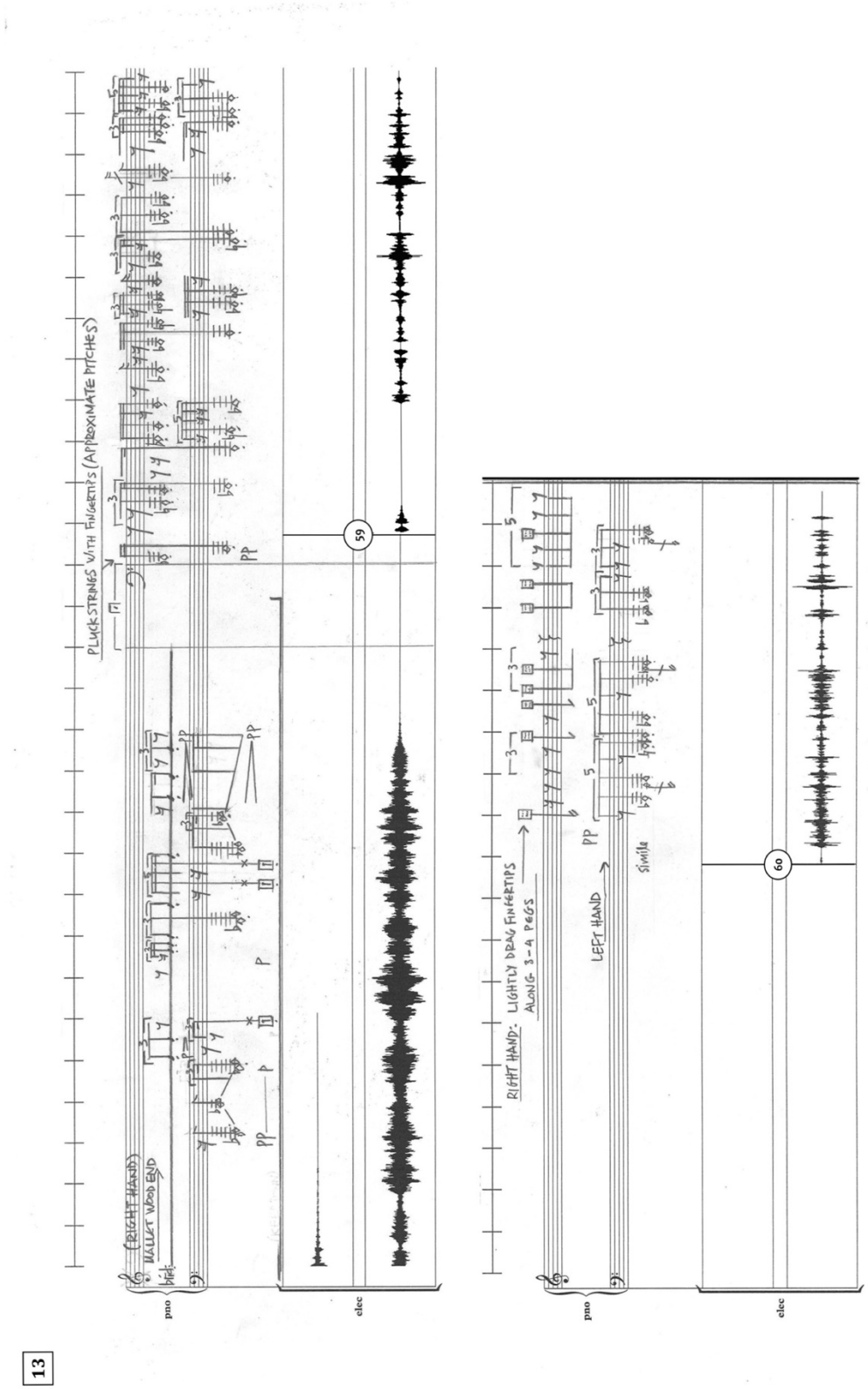

8
pno
elec
(RIGHT HAND)
TRIANGLE BEATER
Ped.
DRAG THE BEATER ACROSS THE PEGS
37
38
39
40
41


9
pno
elec
42
43
44
45
Ped.
pno
elec


10
pno
elec
46


11
pno
elec
Two MALLETS
47
48
49
50
51


12
TWO MALLETS
(KEEP DOWN)
(RIGHT HAND)
SUPERBALL SMALL
(LEFT HAND)
SUPERBALL LARGE
HIT RIM
LEFT
pno
elec


13
PLUCK STRINGS WITH FINGERTIPS (APPROXIMATE PITCHES)
(RIGHT HAND)
BALLET WOOD END
pno
elec
PP
P
59
RIGHT HAND: LIGHTLY DEAD FINGERTIPS
ALONG 3-4 PEGS
LEFT HAND
similar
60

Appendix #2: Score of *minute* | *from within*

Theocharis Papatrechas

minute | from within

for amplified objects and electronics

2019-20

minute | from within (2019-20)

for amplified objects and electronics

written for and heartily dedicated to Rebecca Lloyd-Jones
premiered in January 2020 at the University of California, San Diego (UCSD)

Duration: 13' ca

PERFORMANCE NOTES

Needed Objects:

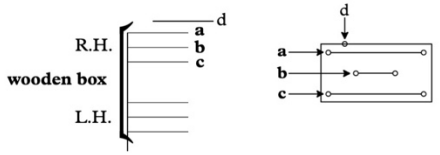
• 1 Wooden Box with a resonating chamber [Sonar Primary Xylophone Resonating Box without the Xylophone Bar]
• 1 Metal Pipe [approximate length 50cm and pitch G#5 – foam needs to be placed inside the pipe from the opposite end of the mic to reduce vibrations]
• 1 Bass Drum with the bottom head removed [Black Swamp]
• 1 Flowerpot [approximate pitch C5]

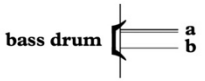
Needed Items:

• 1 Pair of Nylon Brushes [Vic Firth]
• 1 Wire Brush [NCTP]
• 1 Dish Brush [Well Earth]
• 1 Medium Sized Superball aka Super Rub Mallet [Steve Weiss]
• 1 Plastic Comb [approximate length 5" - Amazon]

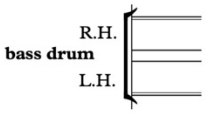
Setup:

Notation

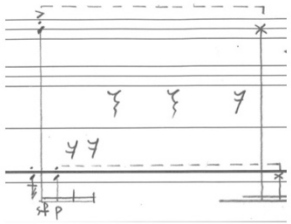




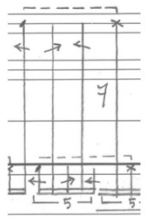
a = rim
b = center of the drum



In pages 11-13, the bass drum staff is divided in two staves to distinguish the activity of the two hands. The activity has been laid out in such a way that the instrument maps for the two hands mirror each other, meaning the rim for the right hand appears at the top, while the rim for the L.H. at the bottom, and the two centers are in the middle.



Excerpt from Page 2 / System 1: At the normal headed note, hit with the fingernail keeping it attached to the instrument until its release on the x-headed note. Note that the release is expected to produce sound, as well.



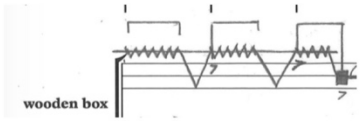
Excerpt Page 2 / System 1: Normal headed notes with arrows attached to their stem indicate hit and directional slide at once. Arrowed no-headed notes indicate that the hit has been already occurred and only directional slide is needed with the fingertip kept attached to the surface until its release on the x-headed note.

Using your fingernails, strike and slide upwards. Multiple fingers at the same time is OK.

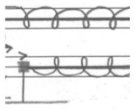
Hit the center of the box with the knuckle.

Full squared noteheads with sustained lines are used with different types of brushes and the superball. They indicate no strike but constant movement/sliding until the end of the attached line.

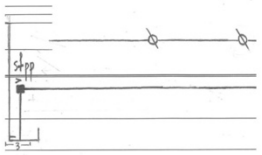
Empty squared noteheads are used with different types of brushes and the superball. They indicate individual strikes. In this particular case, the mallet should let bounce.



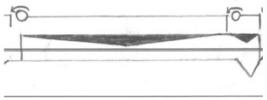
Excerpt from Page 10 / System 1: The comb is used on the position "d" of the box (see above) with a saw-like motion. At the end of this motion, the mallet travels from top to bottom and back to top along the surface of the object.



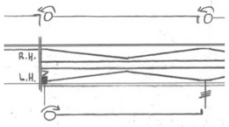
Excerpt from Page 9 / System 2: Using the comb with one hand and the dish brush with the other, make circular motion on the surface of the box with opposite directionality between the two hands – clockwise and counterclockwise.



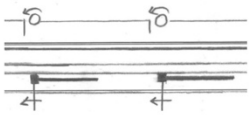
Excerpt from Page 10 / System 1: The cross-lined circle indicates that the mallet should remain at the same location and be rotated semi-circularly in place. Every iteration of the symbol indicates change in direction.



Excerpt from Page 11 / System 1: The circle with an arrow above indicates that the performer should cover an entire circle around the head of the drum until the end of the line. In this case, the rotation should be counterclockwise.



Excerpt from Page 11 / System 1: In this case, the two hands should begin rotation across from each, both close to the rim of the drum. In the middle of their activity, they should reach the center of the drum, and then back to the rim by the completion of the circle. The rotation of the R.H. is counterclockwise, while the L.H.'s is clockwise.



Excerpt from Page 12 / System 1: The R.H. rotates counterclockwise around the drum close to the rim, while the L.H. follows the same direction using the superball close to the center of the drum.

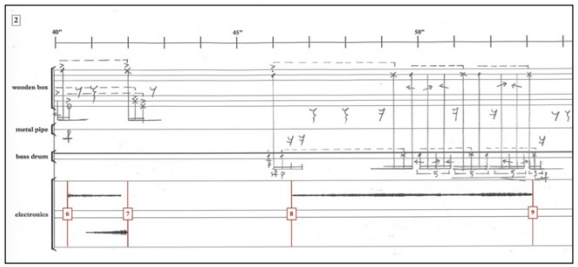
ELECTRONICS

The electronic component of the work consists of prerecorded media being triggered during the course of the piece as well as moments of digital signal processing, in which the incoming signal captured by microphones placed inside the piano is being processed through various granulators. The output signal is being diffused within a stereo system (2-channel).

The prerecorded media as well as the instructions with regard to signal processing have all been input inside a Max/MSP patch and laid out in 43 distinct events. The events have been notated under circled numbers in the electronic part of the score. The performer may trigger the events during the performance.

Events are notated in red in squared numbers placed in the middle of the electronics staff – occasionally (e.g. events 19, 27) the events are notated at the bottom of the staff to avoid overlapping with important waveform activity.

Excerpt from Page 2 / System 1:



A complete Max/MSP patch is to be provided by the composer.

Technical Rider:

• 2 Loudspeakers placed on stage on the left and right of the performer.
• 4 Small Diaphragm Condenser Microphones (e.g. Audio-Technica's ATM450) placed:
    -1 inside the box from the back
    -1 inside the pipe from the right side
    -1 inside the bass drum from underneath
    -1 inside the flowerpot from underneath
• Mixing board
• Sound interface: 2 inputs-outputs
• MacBook Pro
• Max/MSP 8
• Midi Pedal

Initializing Max/MSP:

1. Move folder "papatrechas_minute" to Desktop
2. Launch Max8
3. Audio Status Setup:
    -Go to menu **Options** —> **Audio Status** —> **Driver** (*select the one which is related with the sound interface that is connected to the laptop*)
    -Input and Output device should match
    -Sampling rate (**48kHz**)
    -I/O vector size (**1024**)
    -Input: **Ch1 = 1 Input 1 | Ch2 = 2 Input 2**
    -Output: **Ch1 = 1 Output 1 | Ch2 = 2 Output 2**
    -Choose the folder: Documents/Max 8
    -Choose the folder: Desktop/papatrechas_minute
    (make sure the "x" for the subfolders of both folders is selected)

Initializing the patch:

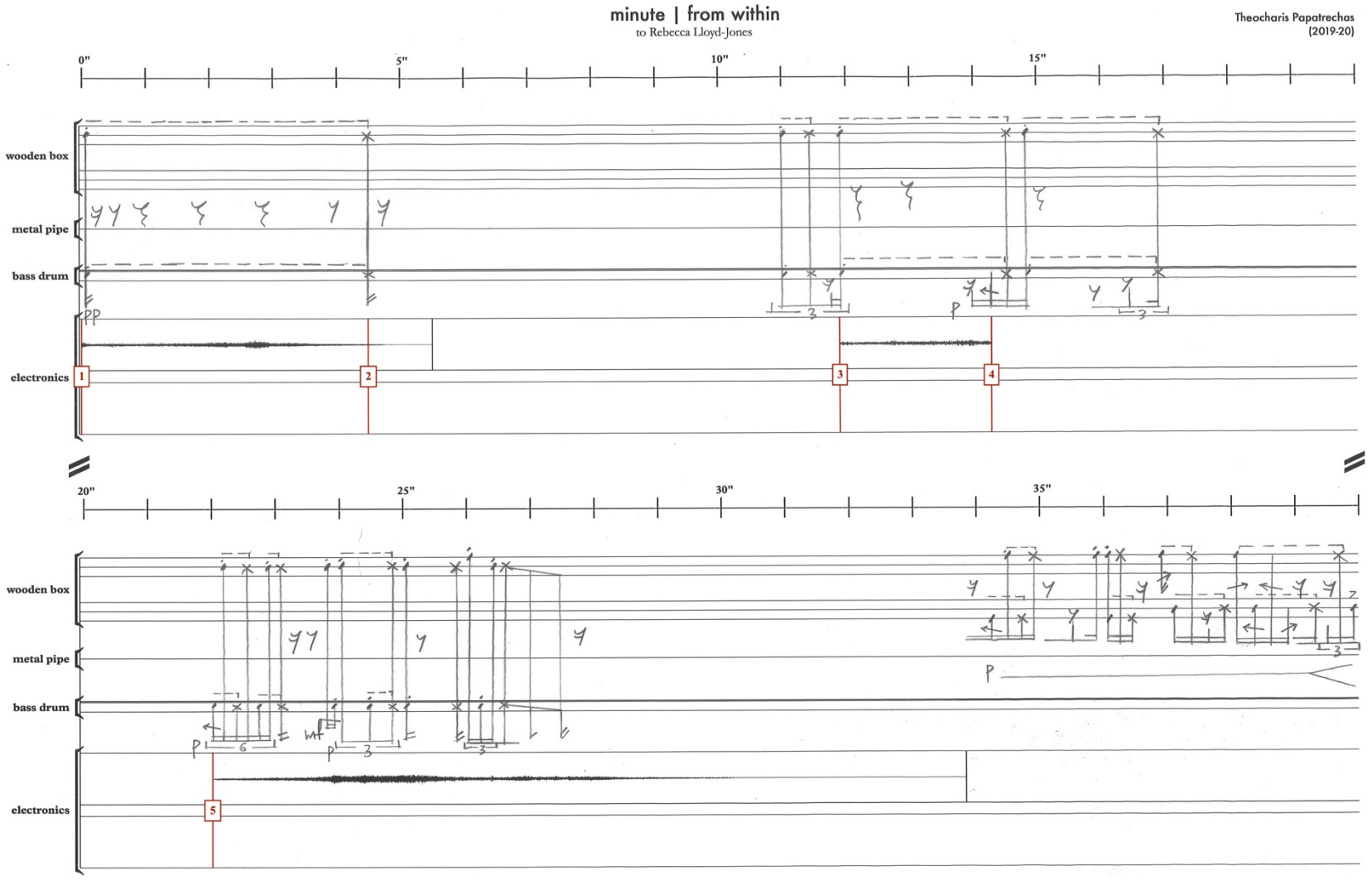
1. Double-click to open patch "papatrechas_minute_MAIN.maxpat"
2. Open Sound
3. Initialize Settings
4. Open Mics
5. Test Pedal
6. Trigger Cue 1…

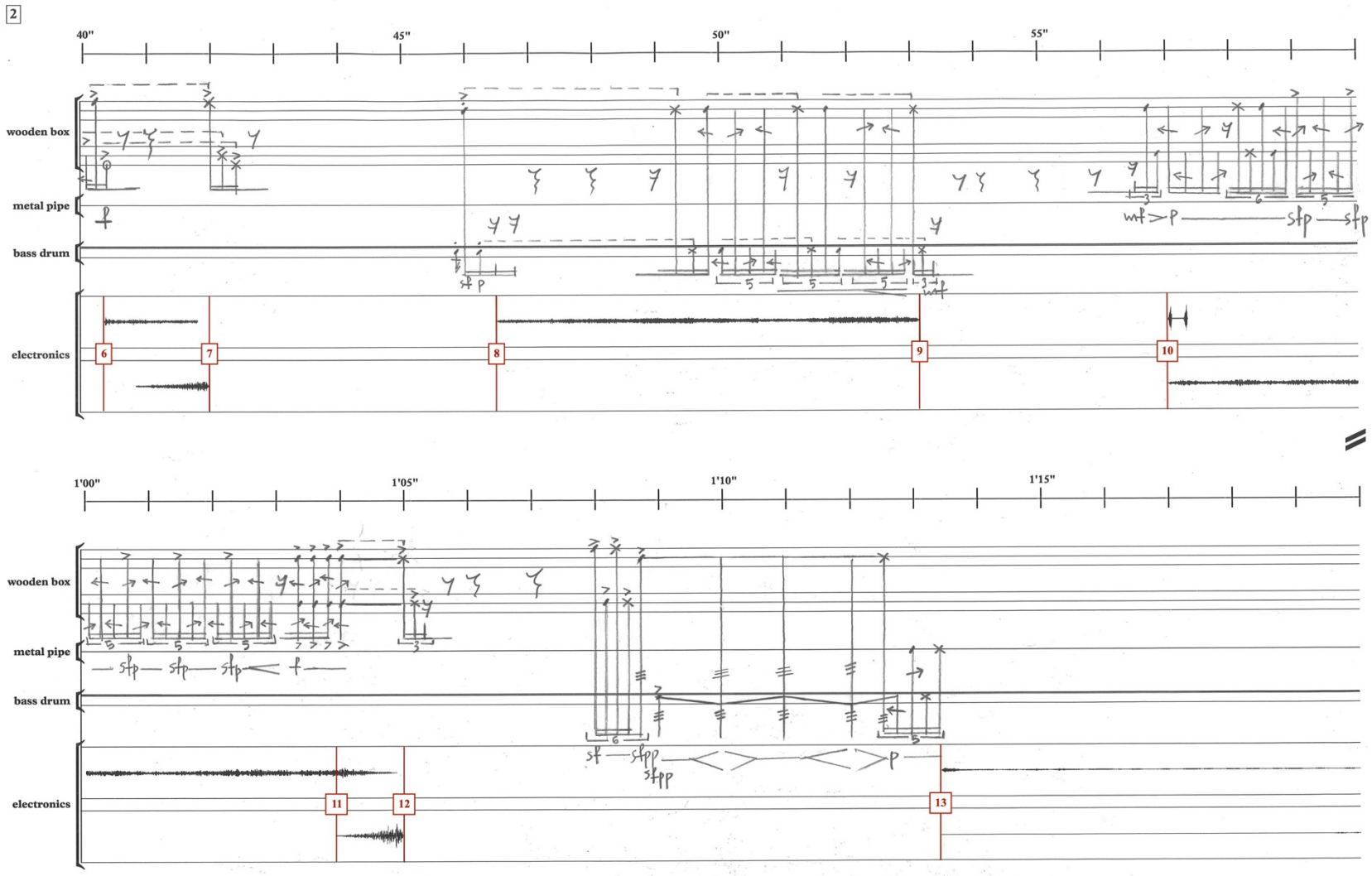
Make sure to check for errors in Max Console (menu **Window** —> **Max Console**)

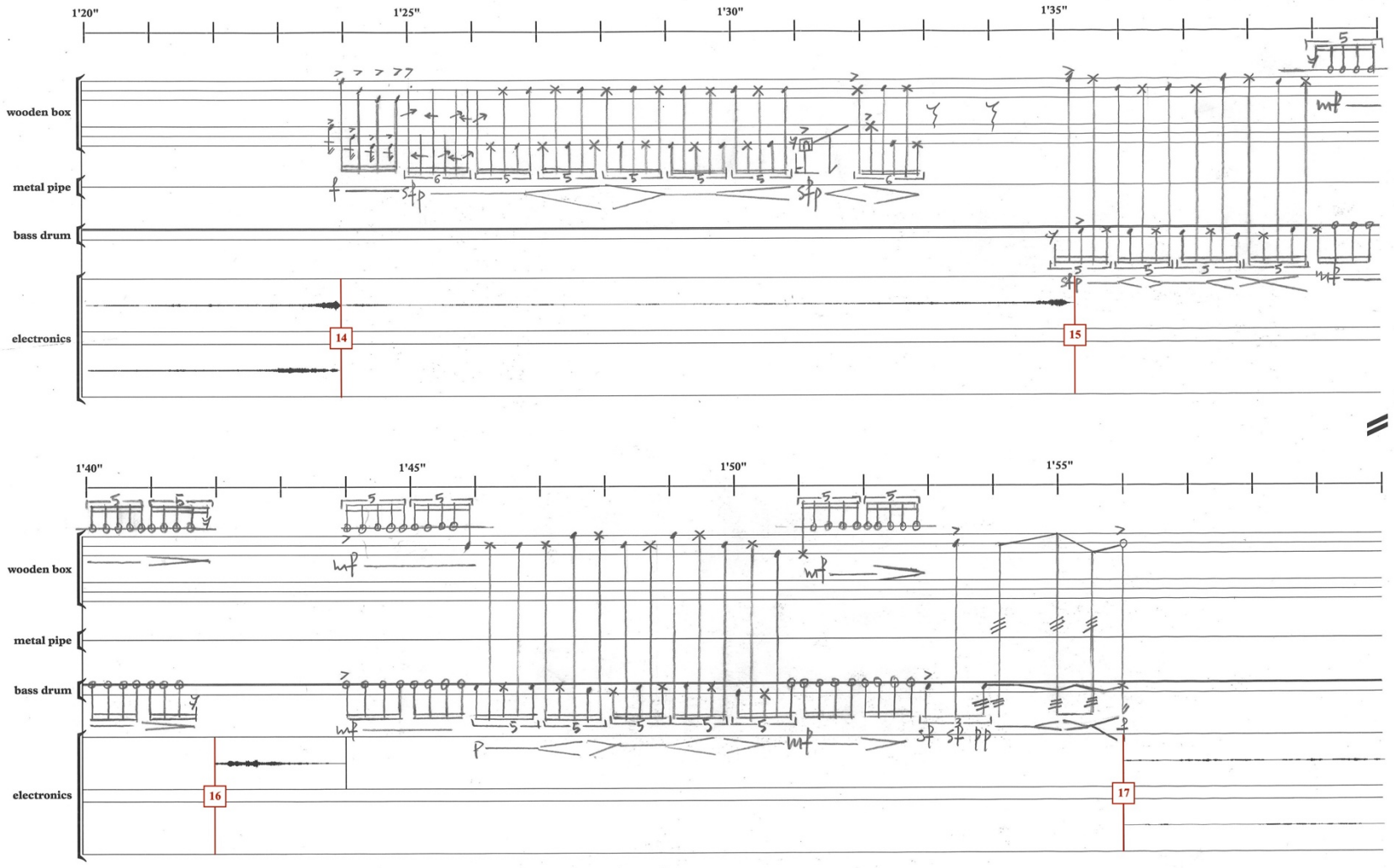
Restart Max if necessary.

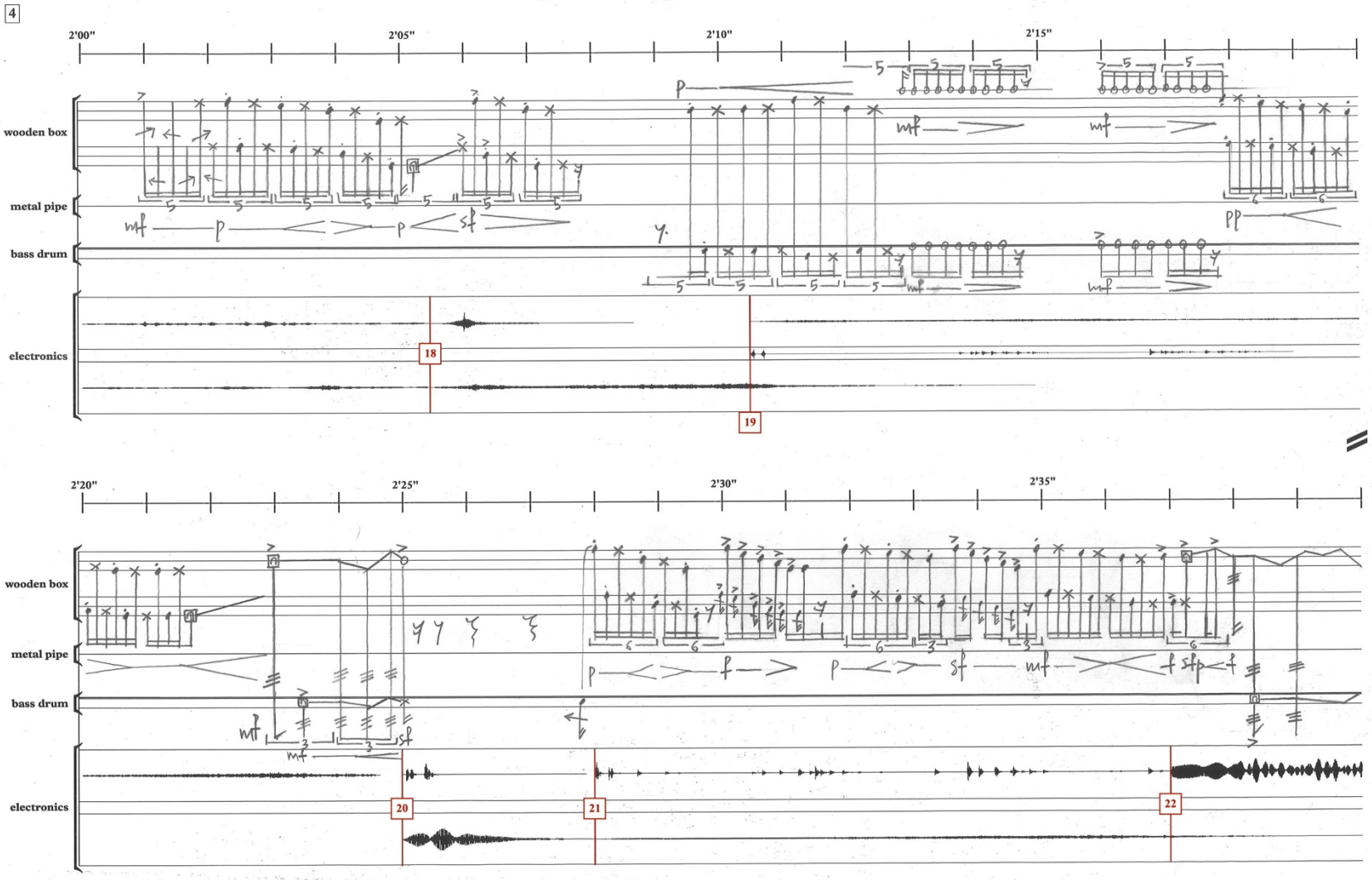
To be provided with the patch and for more details about the work, the electronics, and the proper operation of the patch, please, get in touch with the composer.

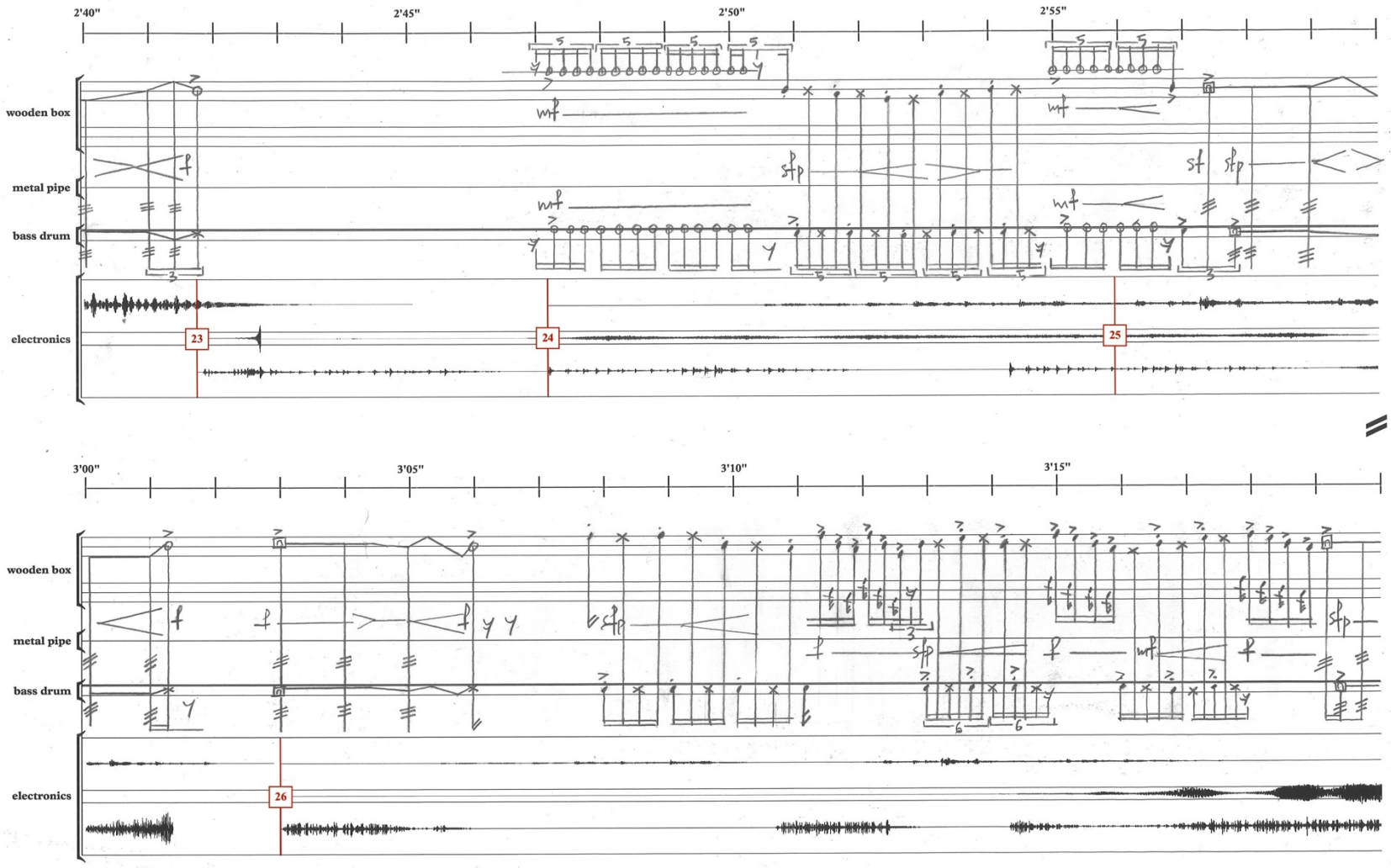
Theocharis Papatrechas
+1-925-914-7460
hpapatrechas@gmail.com
www.theocharis-papatrechas.com/contact

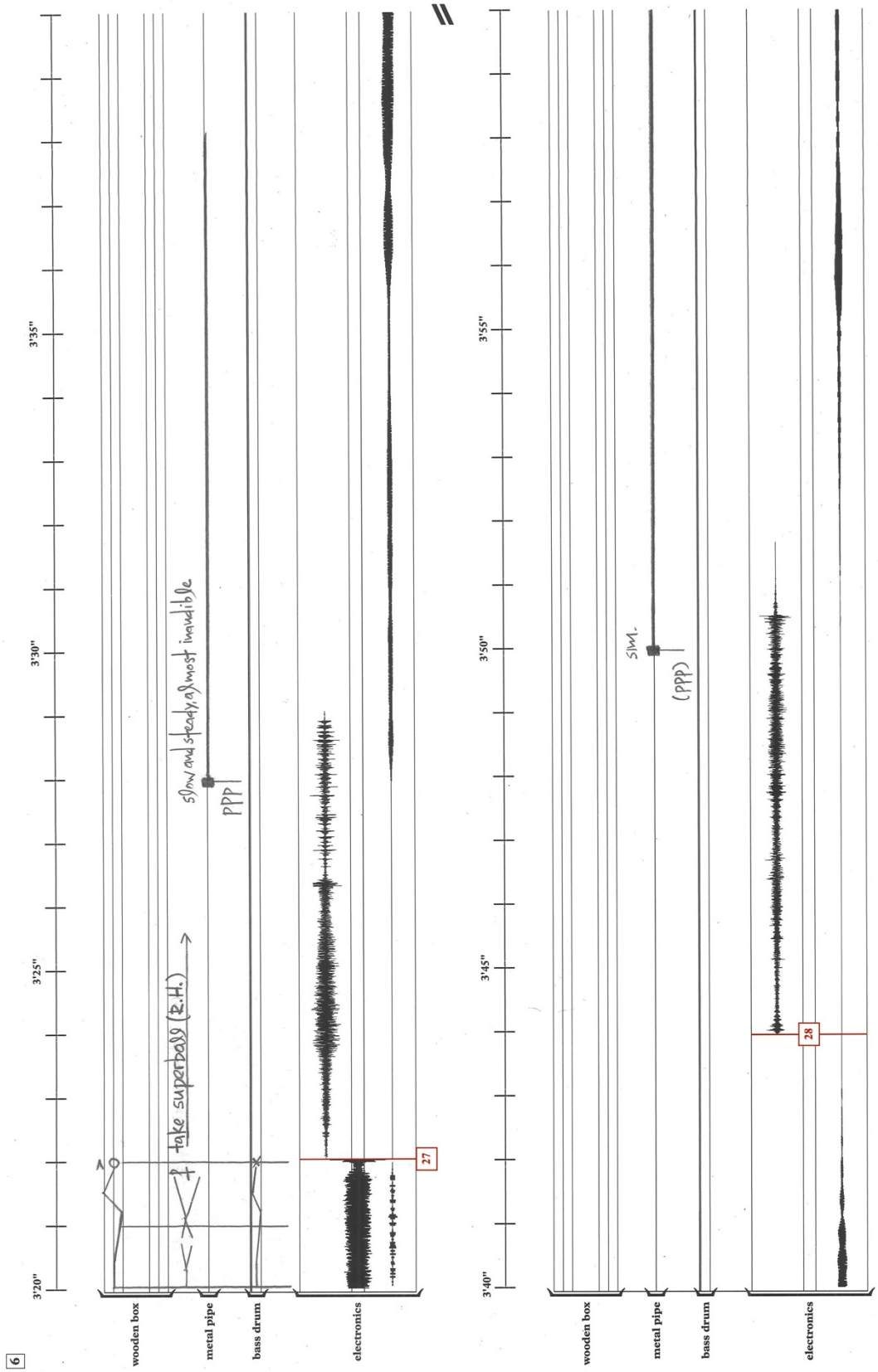

minute | from within
to Rebecca Lloyd-Jones
Theocharis Papatrechas
(2019-20)
0"
5"
10"
15"
wooden box
metal pipe
bass drum
electronics
1
2
3
4
20"
25"
30"
35"
wooden box
metal pipe
bass drum
electronics
5

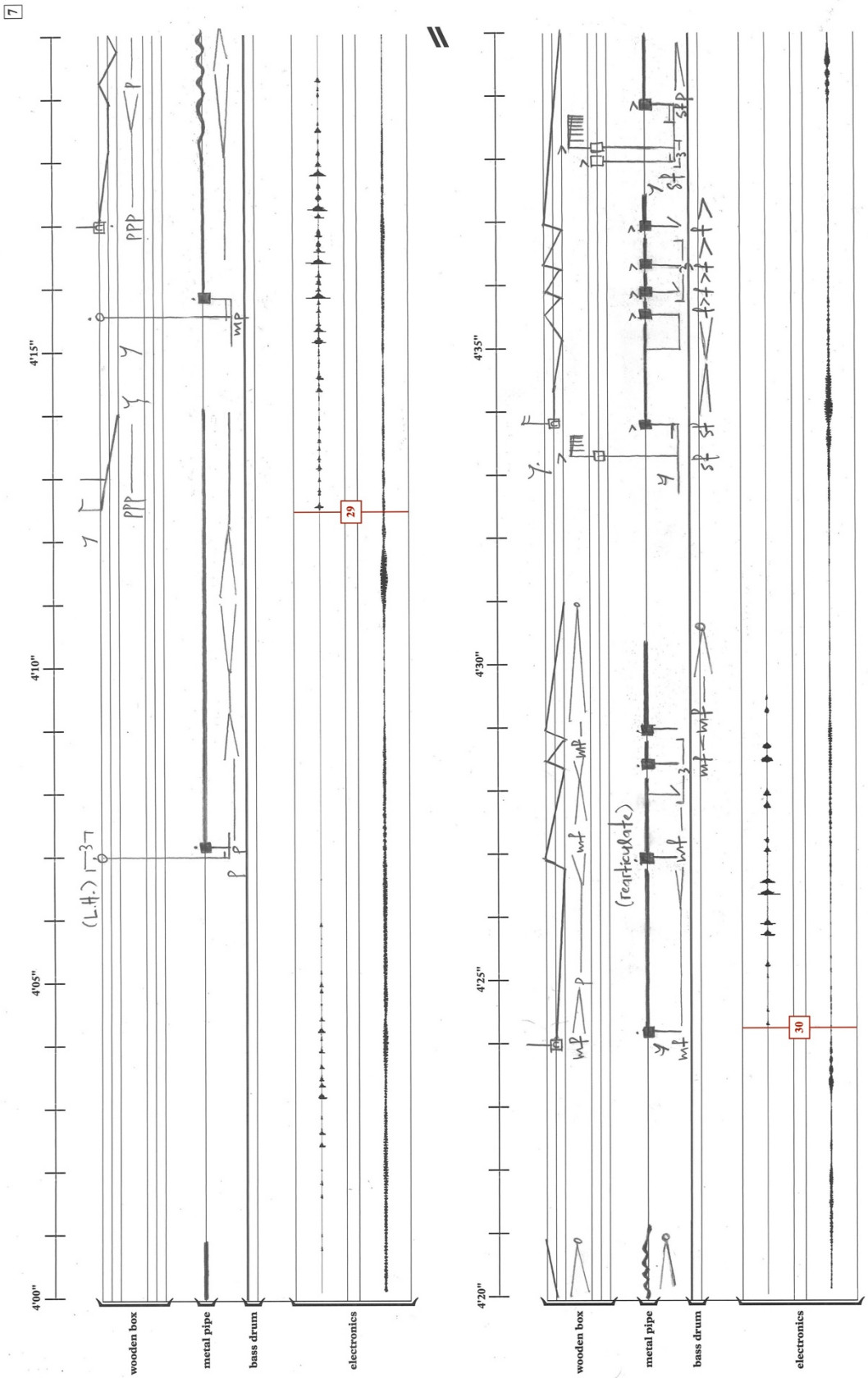

2
40"
45"
50"
55"
wooden box
metal pipe
bass drum
electronics
6
7
8
9
10
1'00"
1'05"
1'10"
1'15"
wooden box
metal pipe
bass drum
electronics
11
12
13

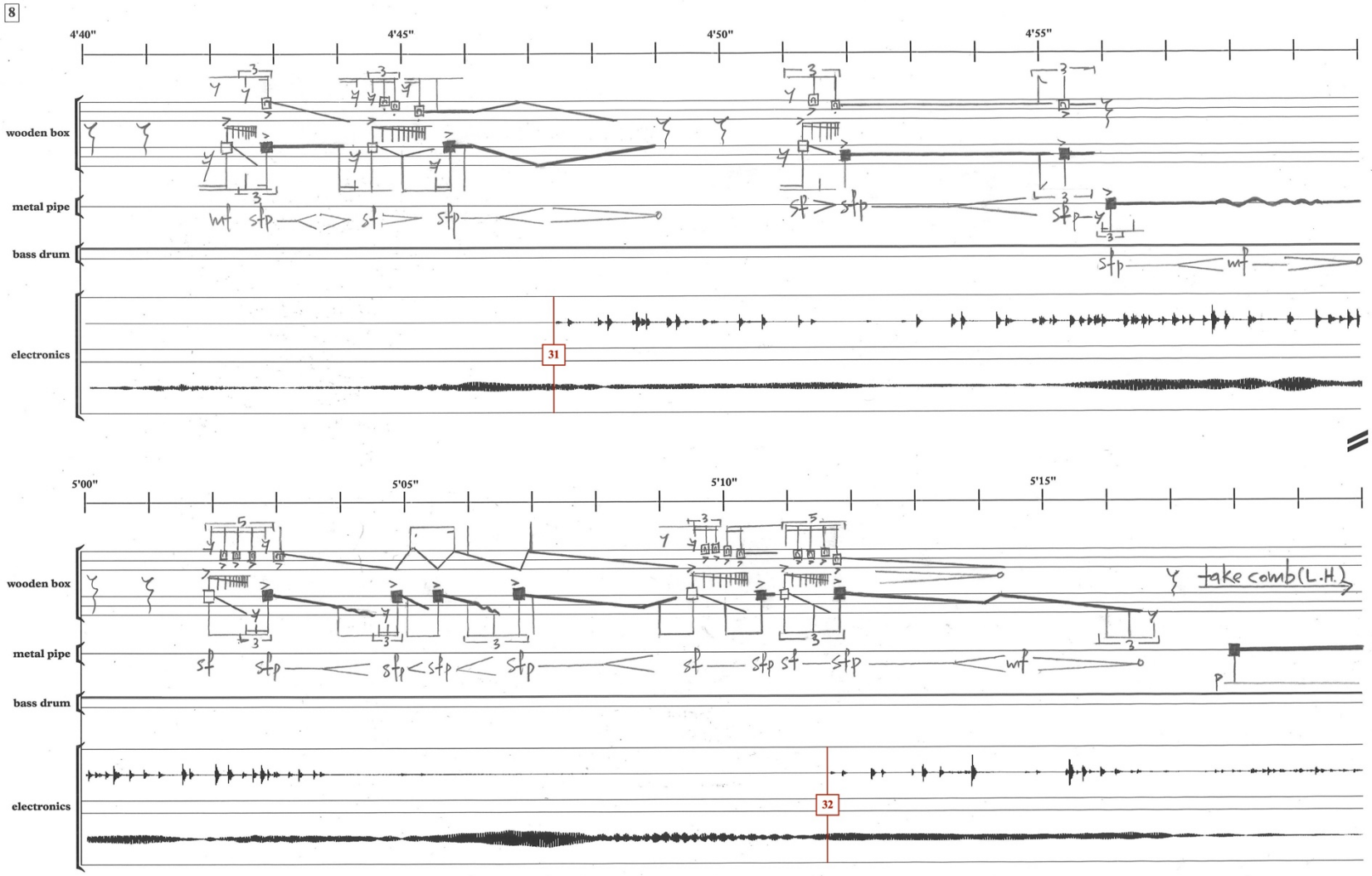

1'20"
1'25"
1'30"
1'35"
wooden box
metal pipe
bass drum
electronics
14
15
1'40"
1'45"
1'50"
1'55"
wooden box
metal pipe
bass drum
electronics
16
17

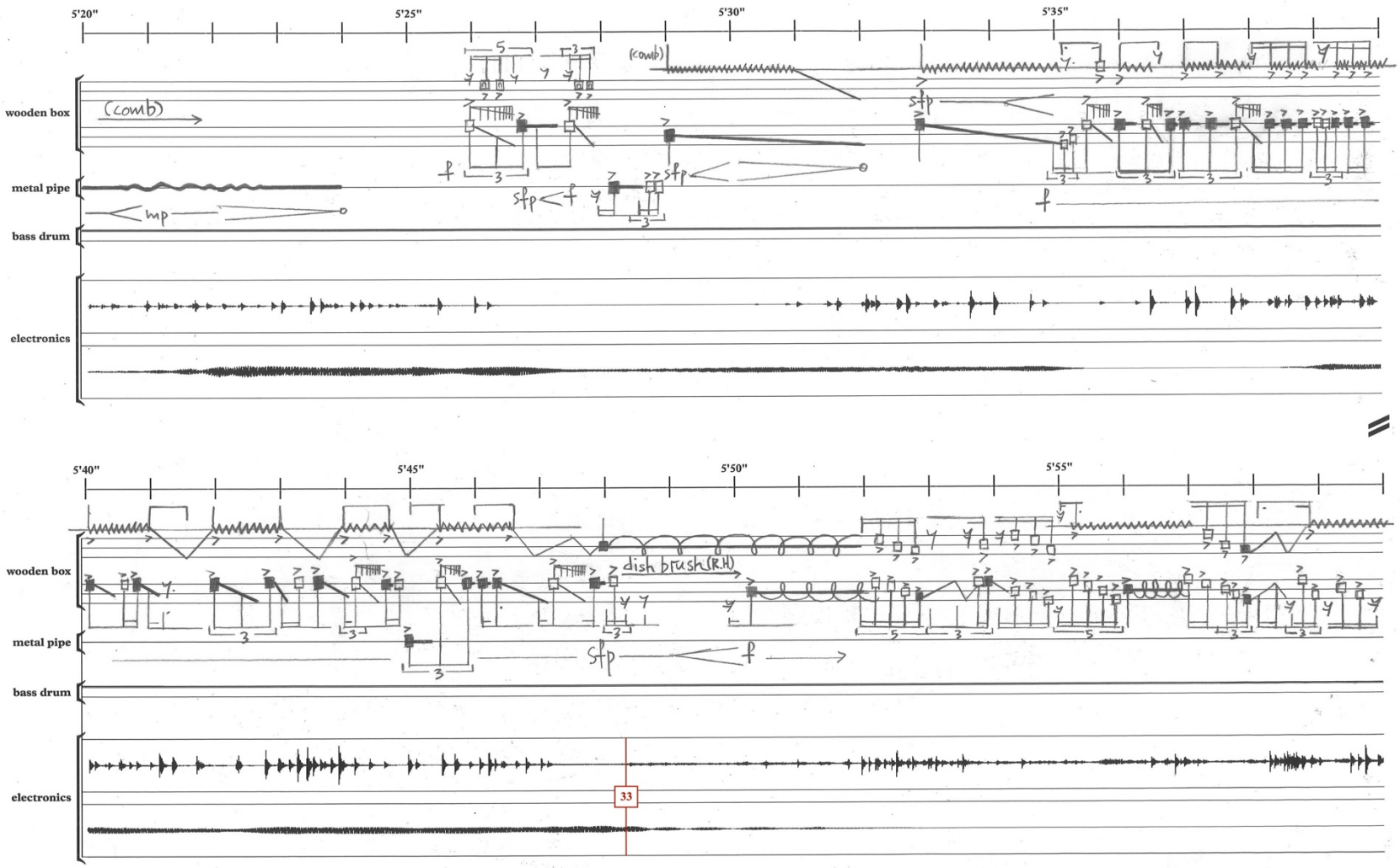

4
2'00"
2'05"
2'10"
2'15"
wooden box
metal pipe
bass drum
electronics
18
19
2'20"
2'25"
2'30"
2'35"
wooden box
metal pipe
bass drum
electronics
20
21
22

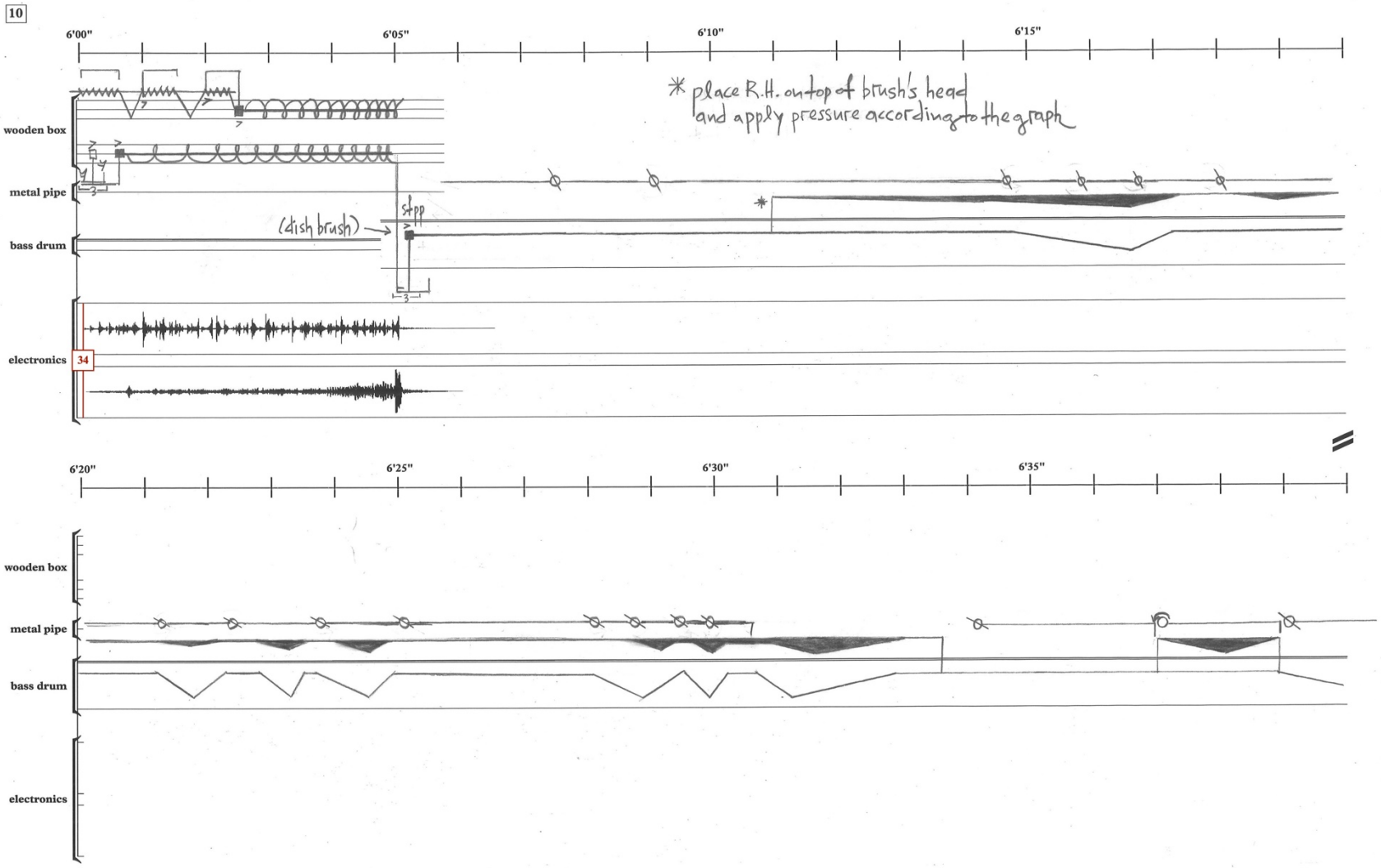

2'40"
2'45"
2'50"
2'55"
wooden box
metal pipe
bass drum
electronics
23
24
25
3'00"
3'05"
3'10"
3'15"
wooden box
metal pipe
bass drum
electronics
26

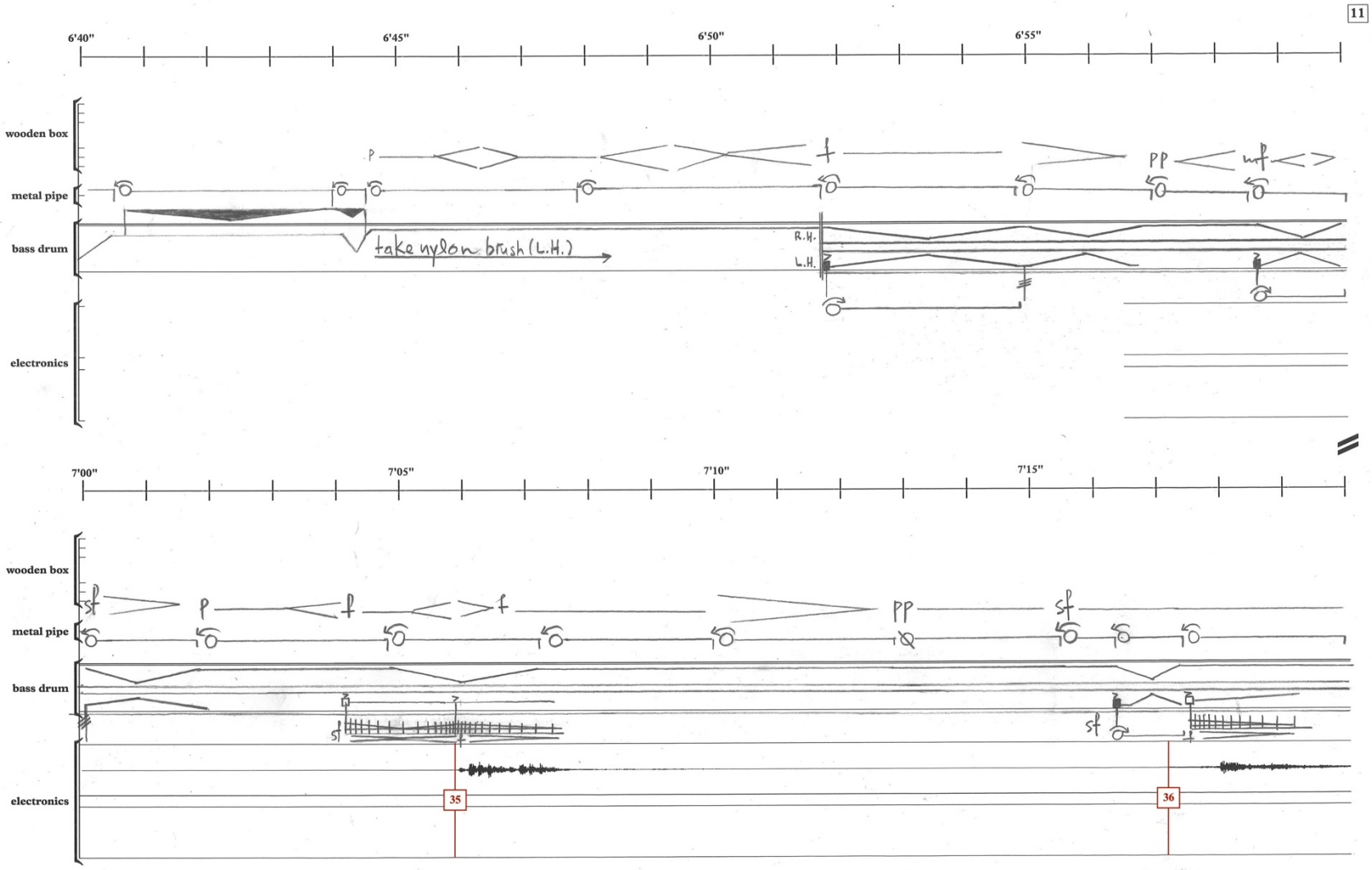

6
3'20"
3'25"
3'30"
3'35"
3'40"
3'45"
3'50"
3'55"
wooden box
metal pipe
bass drum
electronics
take superball (R.H.)
slow and steady, almost inaudible
PPP
sim.
(PPP)
27
28

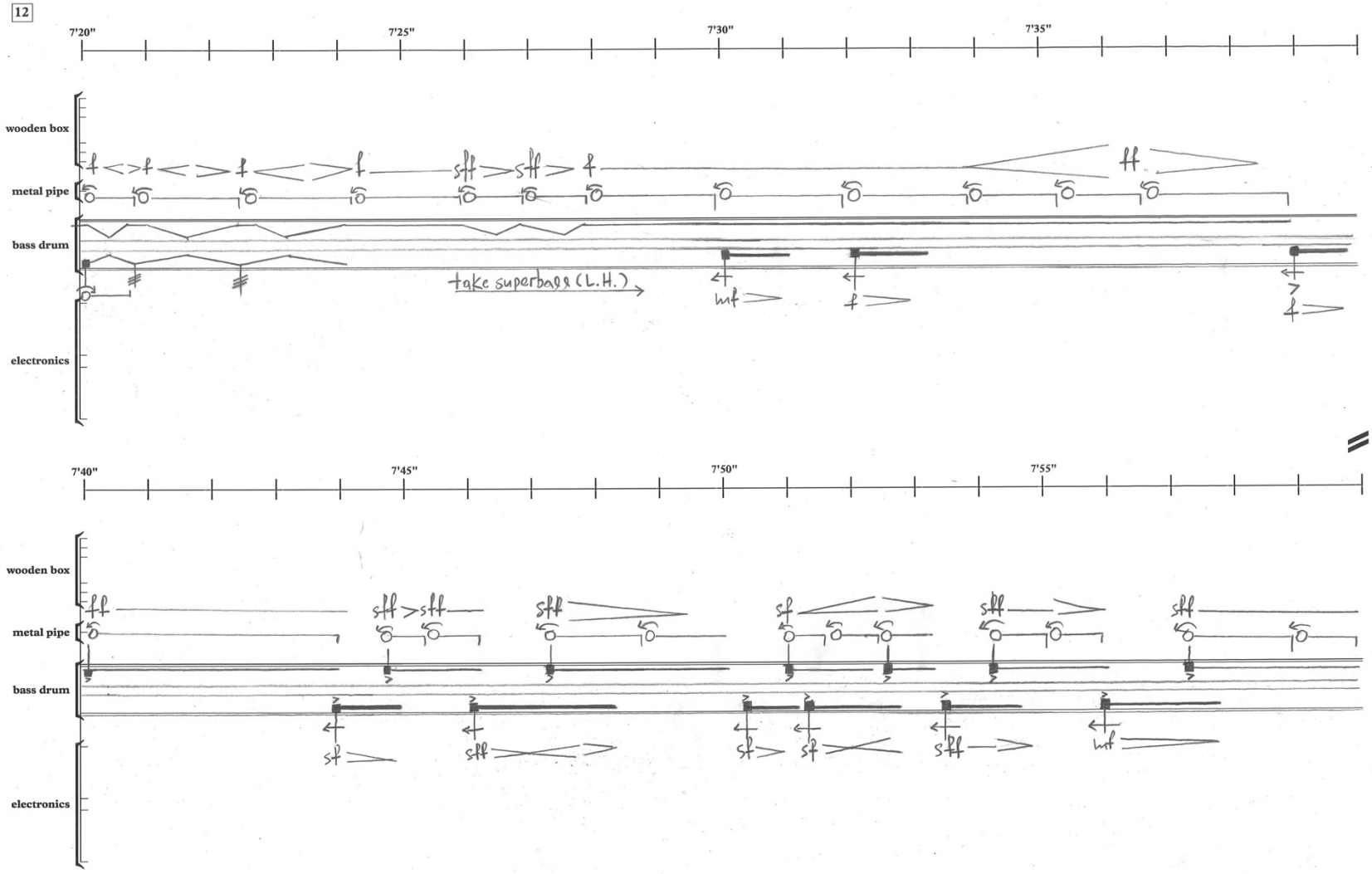

7
4'00"
4'05"
4'10"
4'15"
4'20"
4'25"
4'30"
4'35"
wooden box
metal pipe
bass drum
electronics
29
30
(L.H.)
(rearticulate)
ppp
p
mp
mf

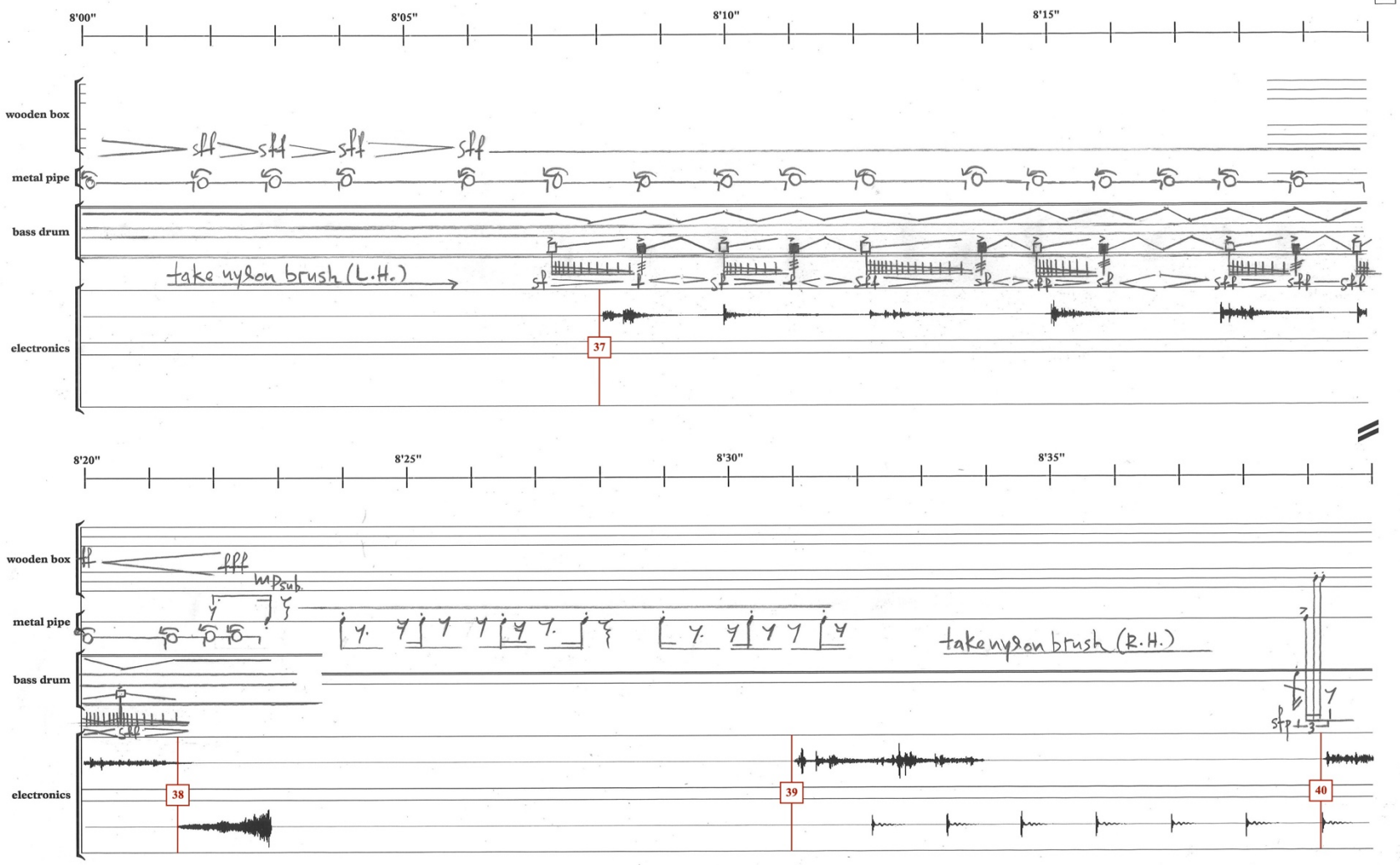

8
4'40"
4'45"
4'50"
4'55"
wooden box
metal pipe
bass drum
electronics
mf stp st stp
sf stp
stp mf
31
5'00"
5'05"
5'10"
5'15"
wooden box
metal pipe
bass drum
electronics
take comb (L.H.)
sf stp stp stp stp stp sf stp sf stp mf
p
32

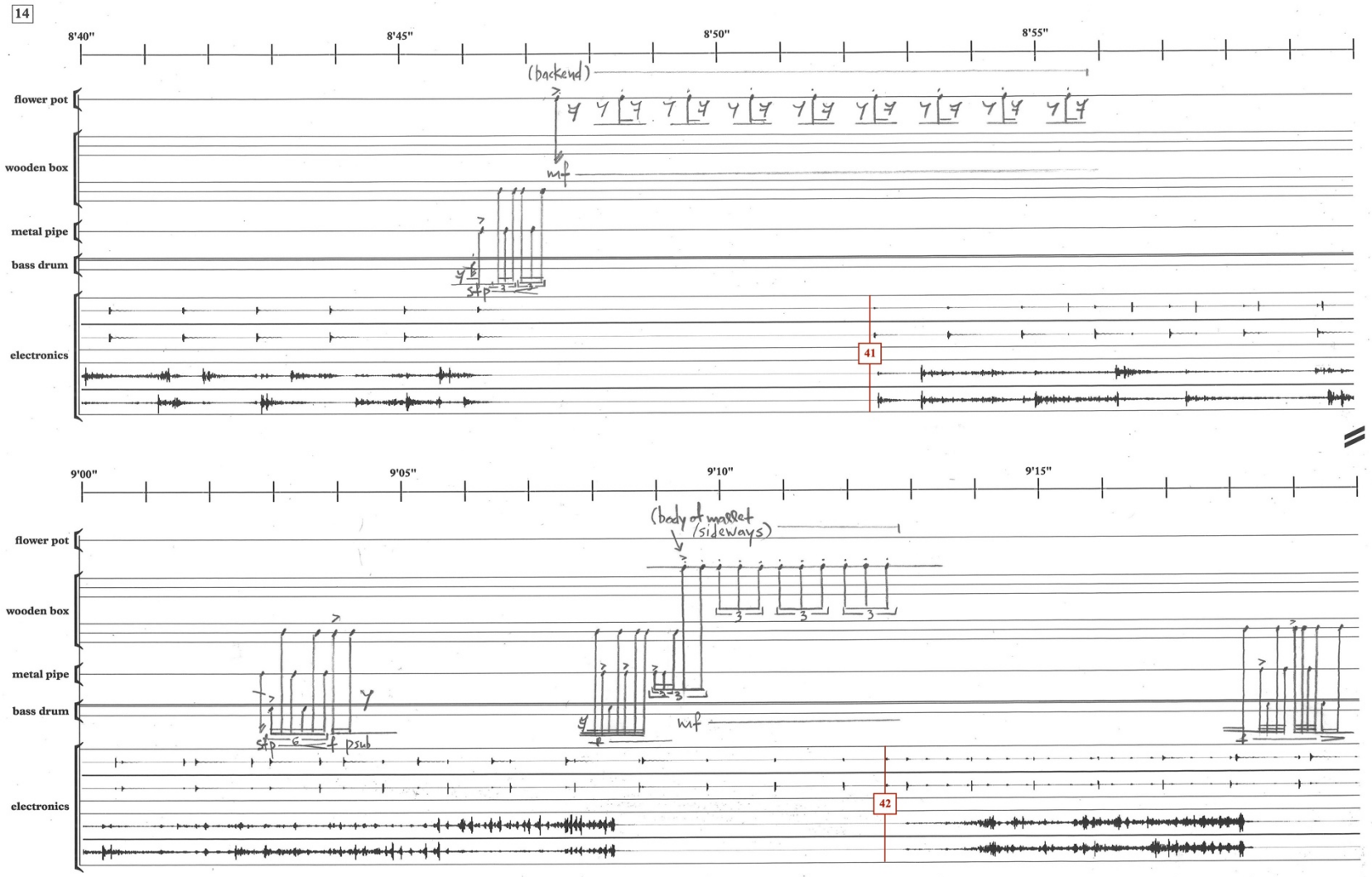

5'20"
5'25"
5'30"
5'35"
wooden box
(comb)
metal pipe
mp
bass drum
electronics
5'40"
5'45"
5'50"
5'55"
dish brush(R.H)
33

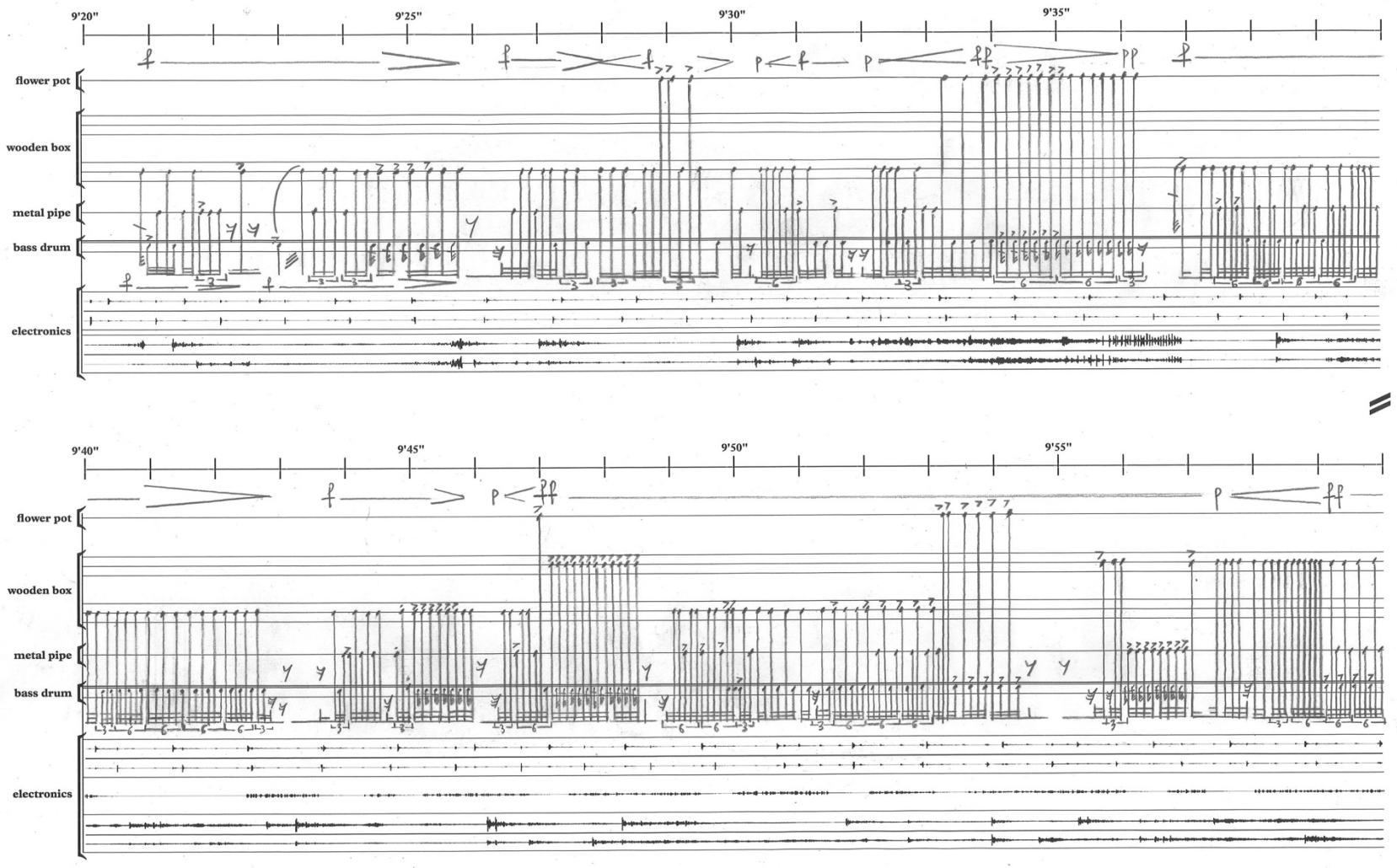

10
6'00"
6'05"
6'10"
6'15"
* place R.H. on top of brush's head and apply pressure according to the graph
wooden box
metal pipe
bass drum
(dish brush)
sfpp
electronics
34
6'20"
6'25"
6'30"
6'35"
wooden box
metal pipe
bass drum
electronics

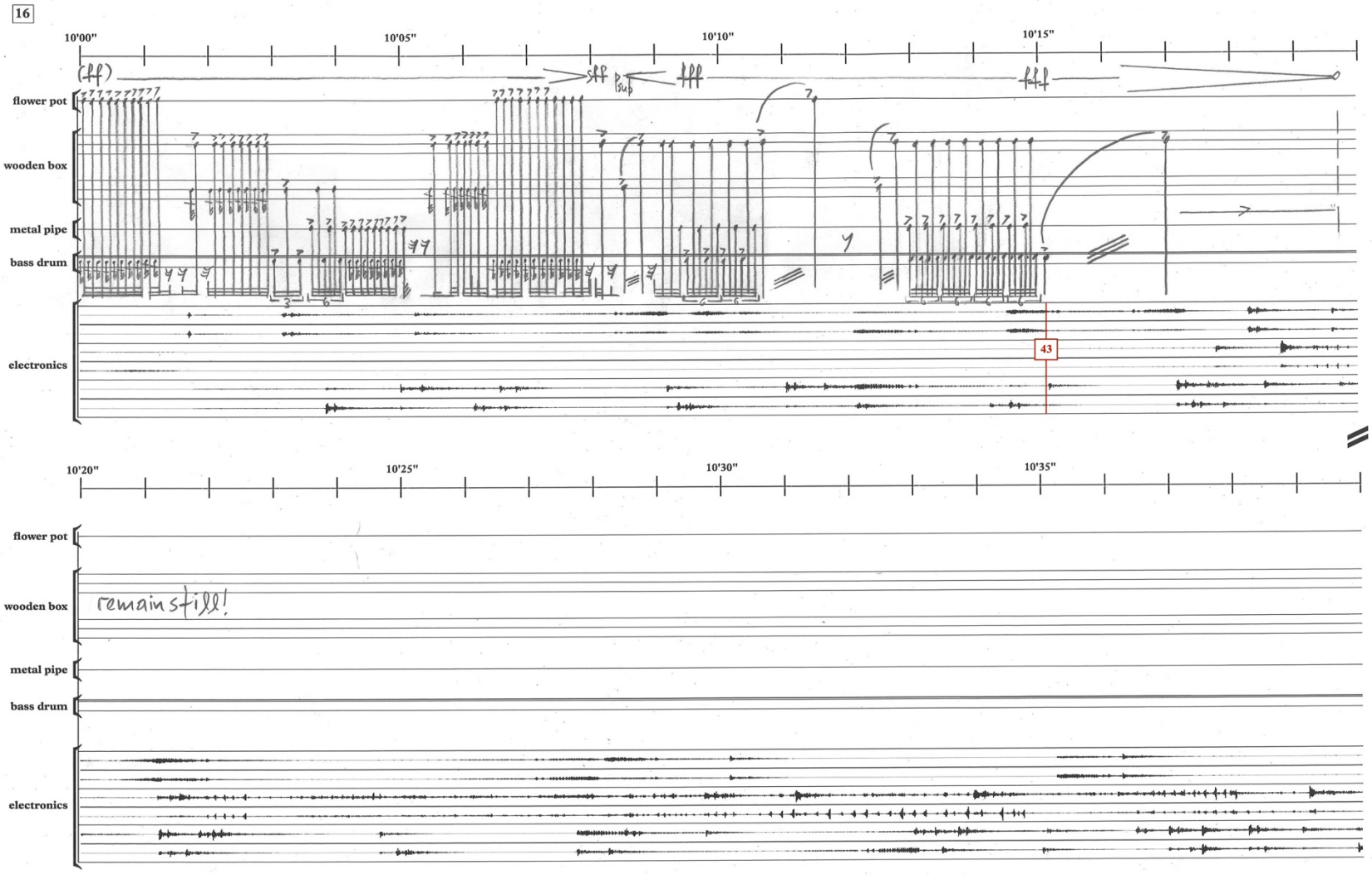

6'40"
6'45"
6'50"
6'55"
wooden box
metal pipe
bass drum
electronics
p
f
pp
mf
take nylon brush (L.H.)
R.H.
L.H.
7'00"
7'05"
7'10"
7'15"
wooden box
metal pipe
bass drum
electronics
sf
p
f
f
pp
sf
sf
sf
35
36

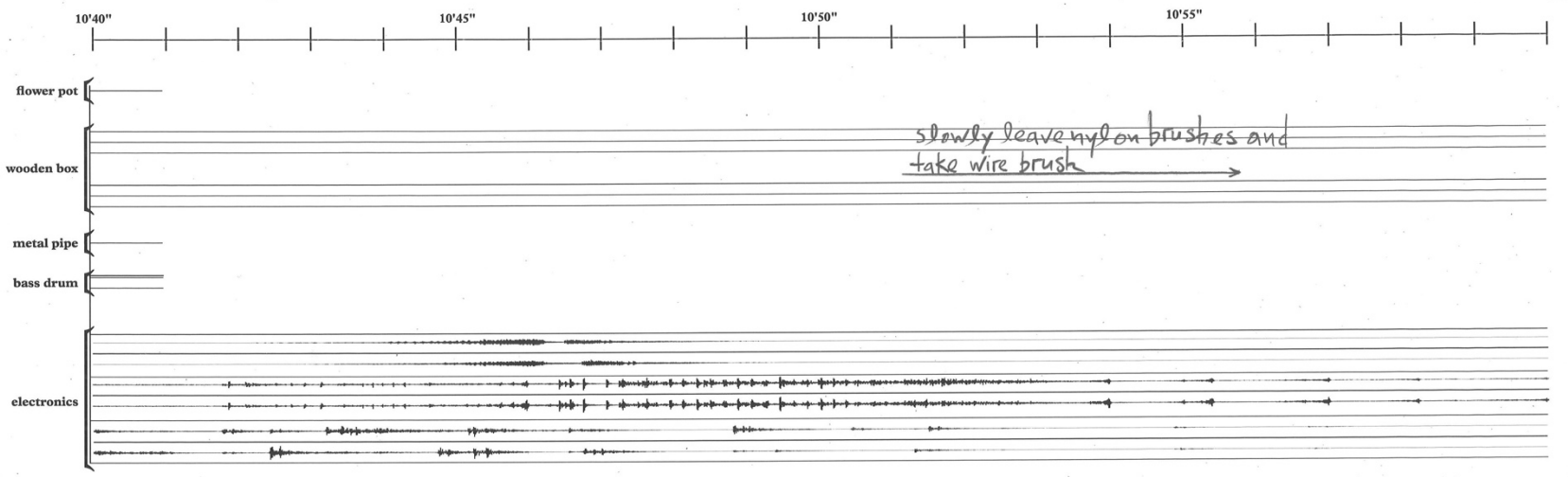

12
7'20"
7'25"
7'30"
7'35"
wooden box
metal pipe
bass drum
electronics
take superbass (L.H.)
7'40"
7'45"
7'50"
7'55"
wooden box
metal pipe
bass drum
electronics

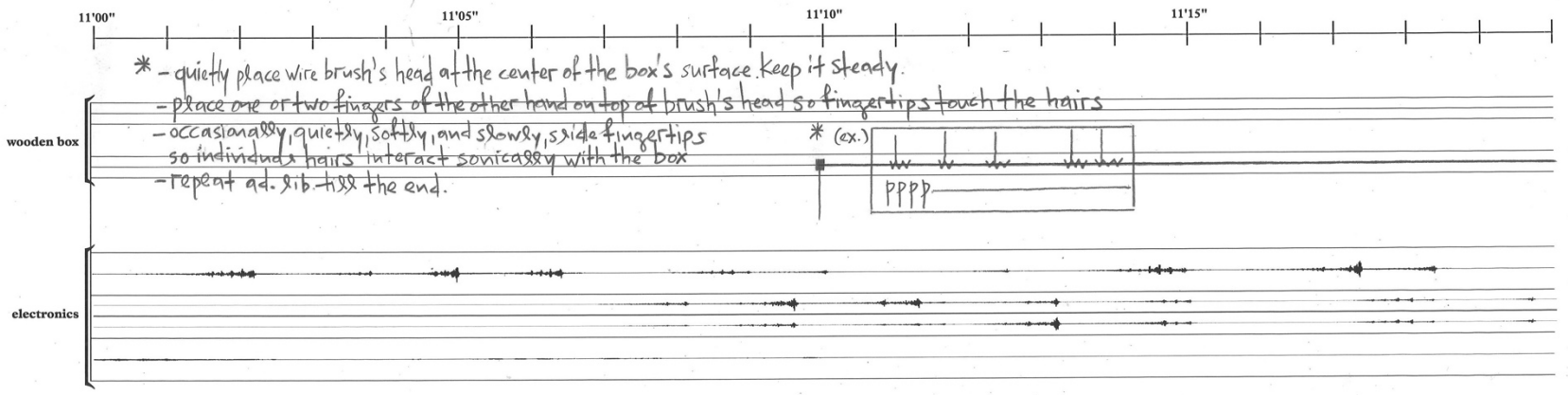

8'00"
8'05"
8'10"
8'15"
wooden box
metal pipe
bass drum
electronics
take nylon brush (L.H.)
37
8'20"
8'25"
8'30"
8'35"
wooden box
metal pipe
bass drum
electronics
take nylon brush (R.H.)
38
39
40

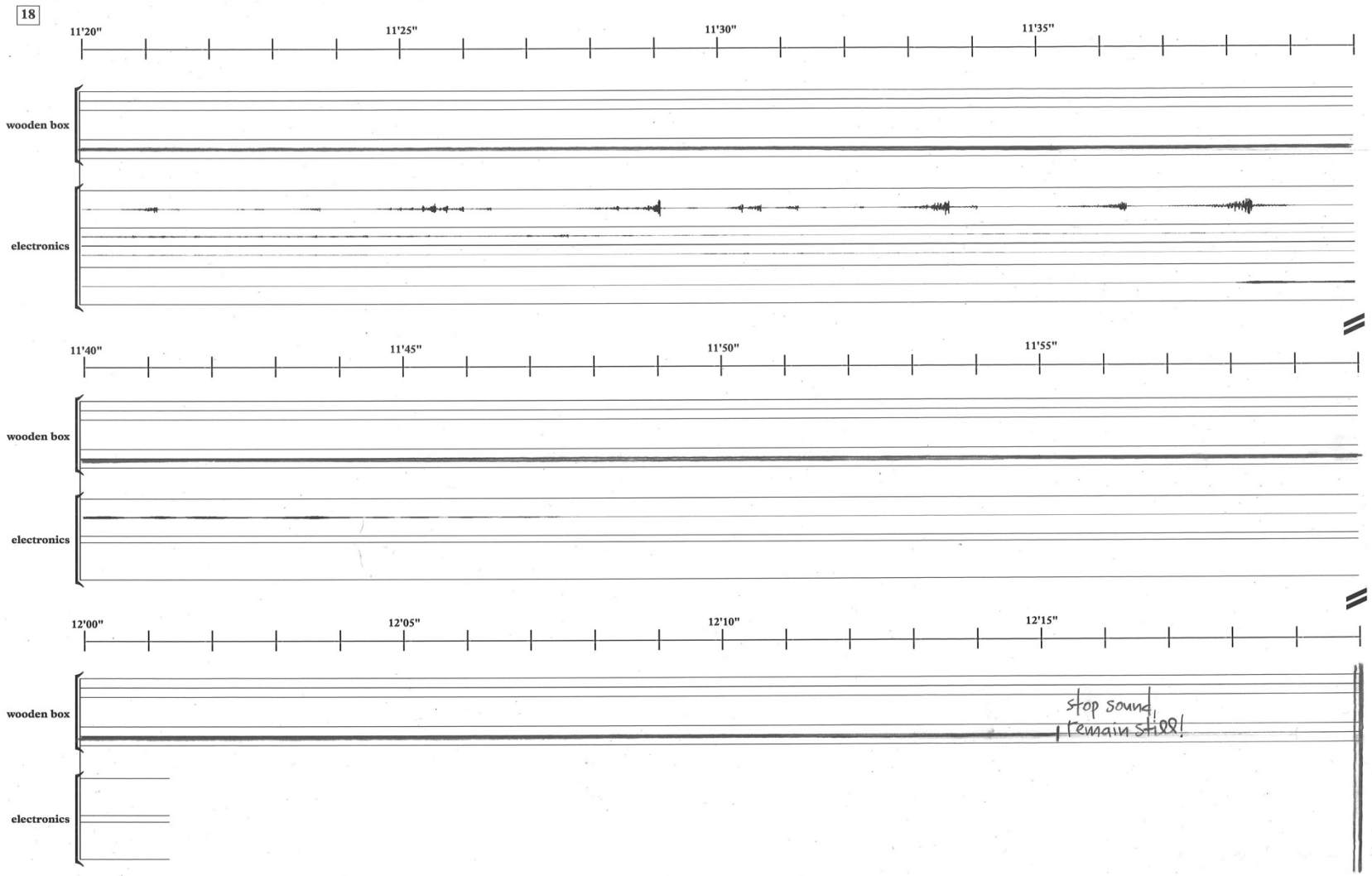

14
8'40"
8'45"
8'50"
8'55"
(backend)
flower pot
wooden box
metal pipe
bass drum
electronics
mf
stp
41
9'00"
9'05"
9'10"
9'15"
(body of mallet /sideways)
flower pot
wooden box
metal pipe
bass drum
electronics
stp
psub
mf
42


9'20"
9'25"
9'30"
9'35"
flower pot
wooden box
metal pipe
bass drum
electronics
9'40"
9'45"
9'50"
9'55"
flower pot
wooden box
metal pipe
bass drum
electronics


16
10'00"
10'05"
10'10"
10'15"
(ff)
sfp
fff
flower pot
wooden box
metal pipe
bass drum
electronics
43
10'20"
10'25"
10'30"
10'35"
remain still!


10'40"
10'45"
10'50"
10'55"
flower pot
wooden box
slowly leave nylon brushes and
take wire brush
metal pipe
bass drum
electronics


11'00"
11'05"
11'10"
11'15"
* - quietly place wire brush's head at the center of the box's surface. keep it steady.
- place one or two fingers of the other hand on top of brush's head so fingertips touch the hairs
- occasionally, quietly, softly, and slowly, slide fingertips so individual hairs interact sonically with the box
- repeat ad. lib. till the end.
* (ex.)
pppp
wooden box
electronics


18
11'20"
11'25"
11'30"
11'35"
wooden box
electronics
11'40"
11'45"
11'50"
11'55"
wooden box
electronics
12'00"
12'05"
12'10"
12'15"
wooden box
stop sound!
remain still!
electronics

REFERENCES

Baalman, Marije A.J. 2010. “Spatial Composition Techniques and Sound Spatialization Technologies”. *Organised Sound.* Cambridge, UK: Cambridge University Press. Vol. 15, No. 3, pp. 209-218.

Bachelard, Gaston; Jolas, Maria, translator. 1964. *The poetics of space.* Boston, MA: Beacon Press.

Baker, Gordon; Morris, Katherine J. 1996. *Descartes’ dualism.* London, UK; New York, NY: Routledge.

Barrett, Natasha. 2002. “Spatio-musical composition strategies”. *Organised Sound.* Cambridge, UK: Cambridge University Press. Vol. 7, No. 3, pp. 313-323.

Berezan, David. 2007. *In flux – a new approach to sound diffusion performance practice for fixed media.* Manchester, UK: Novars Research Center. University of Manchester.

Collins, Nick; Schedel, Margaret; Wilson, Scott. 2013. *Electronic Music.* Cambridge, UK; New York, NY: Cambridge University Press.

Collins, Nick; D’Escriván, Julio. 2017. *The Cambridge companion to electronic music.* Cambridge, UK; New York, NY: Cambridge University Press.

Cox, Christoph. Warner, Daniel. 2004. *Audio culture: readings in modern music*. New York, NY: Continuum.

Dack, John. 2019. “Pierre Schaeffer and the (Recorded) Sound Source”. *Sound Objects.* Duke University Press.

Eckel, Gerhard; Rumori, Martin. Pirrò; David. González-Arroyo, Ramón. *A framework for the choreography of sound.* Graz, Austria: University of Music and Performing Arts. Institute of Electronic Music and Acoustics.

Flage, Daniel E. “Hume's Dualism.” *Noûs*, Vol. 16, No. 4 (1982), pp. 527–541. *JSTOR*, www.jstor.org/stable/2215205. Accessed 08 Sept. 2020.

Gabor, Dennis. 1947. *Nature.* “Acoustical Quanta and the Theory of Hearing”. Vol. 159.

_____. 1952. *Lectures on Communication Theory*. Cambridge, MA: The MIT Press.

Holmes, Thom. 2016. *Electronic and experimental music: technology, music, and culture.* New York, NY; Abingdon, Oxon: Routledge.

Hugill, Andrew. 2019. *The Digital Musician*. 3rd Edition. London, UK; New York, NY: Routledge.

Johnson, Bridget. 2014. “Emerging Technologies for Real-Time Diffusion Performance”. *Leonardo Music Journal.* Cambridge, MA: The MIT Press. Vol. 24, pp. 13-15.

Kendall, Gary S. 2010. “Spatial Perception and Cognition in Multichannel Audio for Electroacoustic Music”. *Organised Sound.* Cambridge, UK: Cambridge University Press. Vol. 15, No. 3, pp. 228-238.

Kronegger, Marlies. 2000. *The orchestration of the arts: a creative symbiosis of existential powers: the vibrating interplay of sound, color, image, gesture, movement, rhythm, fragrance, word, touch.* Dordrecht; Boston, MA: Kluwer Academic.

Lukes, Roberta Dorothy. 1996. *The Poème électronique of Edgard Varèse.* Ph.D. Dissertation Harvard University. Photocopy. Ann Arbor, Mich.: UMI Dissertation Services.

Manning, Peter. 2004. *Electronic and Computer Music*. Oxford; New York, NY: Oxford University Press.

Meyer, Felix; Zimmermann, Heidy. 2006. *Edgard Varèse: composer, sound sculptor, visionary.* Woodbridge, UK: Boydell Press.

Otondo, Felipe. *Contemporary trends in the use of space in electroacoustic music.* York, UK: Department of Music, University of York.

Ouzounian, Gascia. 2007. “Visualizing Acoustic Space”. *Circuit: musiques contemporaines*. Vol. 17, No. 3 (2007), pp. 45-56.

Palombini, Carlos. 1993. “Pierre Schaeffer, 1953: Towards an Experimental Music”. *Music & Letters.* Oxford, UK: Oxford University Press. Vol. 74, No. 4 (Nov. 1993), pp. 542-557.

Peteres, Nils; Marentakis, Georgios; McAdams, Stephen. “Current Technologies and Compositional Practices for Spatialization: A Qualitative and Quantitative Analysis”. *Computer Music Journal.* Cambridge, MA: The MIT Press. Vol. 35, No. 1 (Spring 2011), pp. 10-27.

Ratner, Leonard G. 1983. *The musical experience: sound, movement, and arrival.* New York, NY: W.H. Freeman.

Risset, Jean-Claude. 2004. “The Liberation of Sound, Art-Science, and the Digital Domain: Contacts with Edgard Varèse”. *Contemporary Music Review.* New York, NY: Routledge. Vol 23, No. 2, pp. 27-54.

Roads, Curtis. 2001. *Microsound.* Cambridge, MA: The MIT Press.

_____. 1988. “Introduction to Granular Synthesis”. *Computer Music Journal.* Cambridge, MA: The MIT Press. Vol. 12, No. 2 (Summer 1988), pp. 11-13.

Robinson, Howard. 2020. *The Encyclopedia of Philosophy*. “Dualism”.

Sallis, Friedemann; Bertolani, Valentina; Burle, Jan; Zattra, Laura. 2017. *Live electronic music: composition, performance, study.* New York, NY: Routledge.

Santini, Andrea. "Multiplicity – Fragmentation – Simultaneity: Sound-Space as a Conveyor of Meaning, and Theatrical Roots in Luigi Nono's Early Spatial Practice". *Journal of the Royal Musical Association.* Taylor & Francis, Ltd. Vol. 137, No. 1 (2012), pp. 71-106.

Schaeffer, Pierre. North, Christine and Dack, John, translators. 2017. *Treatise on musical objects: An essay across disciplines.* Oakland, CA: The Regents of the University of California.

Simon, Laurent S R; Wuethrich, Hannes; Dillier, Norbert. 2017. *Comparison of Higher-Order Ambisonics, Vector- and Distance-Based Amplitude Panning using a hearing device beamformer.* Zurich, Switzerland. Zurich Open Repository and Archive, University of Zurich.

Stockhausen, Karlheinz. 1976. *Kontakte: elektronische Music, Nr. 12.* London, UK: Universal Edition.

Treib, Marc. 1996. *Space calculated in seconds: The Philips Pavilion, Le Corbusier, Edgard Varèse.* Princeton, NJ: Princeton University Press.

Truax, Barry. 1994. "Discovering Inner Complexity: Time Shifting and Transposition with a Real-time Granulation Technique". *Computer Music Journal.* Cambridge, MA: The MIT Press. Vol. 18, No. 2 (Summer 1994), pp. 38-48.

Varèse, Edgard. 1958. *Poème électronique.* Royal Concertgebouw Orchestra, Asko Ensemble, Riccardo Chailly. Released on January 1, 1998. Produced by Andrew Cornall. *Varèse - Concertgebouw Orchestra, Asko Ensemble, Riccardo Chailly – The Complete Works*. Decca Music Group Limited. 460 208-2.

Weibel, Peter. 2019. *Sound art: sound as a medium of art.* Karlsruhe, Germany: ZKM/Center for Art and Media; Cambridge, MA; London, UK: The MIT Press.

Wen-Chung, Chou. 1966. "Varèse: The Liberation of Sound". *Perspectives of New Music*. Vol. 5, no. 1, pp. 11-19.

Wishart, Trevor. 1996. *On Sonic Art.* Contemporary Music Studies. Vol. 12. OPA (Overseas Publishers Association). Amsterdam, Netherlands: The Netherlands by Harwood Academic Publishers GmbH.

Witkin, Robert W. 1998. *Adorno on music.* London, UK; New York, NY: Routledge.

Xenakis, Iannis. 1992. *Formalized Music: thought and mathematics in composition.* Pedragon Press.

Zattra, Laura. 2006. "The Identity of the Work: agents and processes of electroacoustic music". *Organised Sound.* Cambridge, UK: Cambridge University Press. Vol. 11, No. 2, pp. 113-118.